Chapter 3
Existing Condition, Affected Environment, and Environmental Effects

(3.1) Introduction

This chapter presents an analysis of the effects the actions would have on the environment under each alternative. The environmental effects are discussed together with the existing condition for each resource area. The information and data used to develop this chapter are available in the Planning Record. The Planning Record is available for review at the Baldwin-White Cloud Ranger District.

(3.2) Biological Resources

(3.3) Woody Vegetation

(3.3a) Existing Condition and Resource-Specific Information

Cover Types, Age Classes, and Species

The vegetation of the Project Area is dominated by large areas of black, northern pin, and white oaks, red and white pines, aspen, and upland openings; riparian forests, dominated by red maple, are also common. Other trees associated with these oaks and pines include quaking aspen, big-toothed aspen, and red maple. Hemlock, green and black ash, and northern white cedar are found in riparian forests, and are less frequent in the Project Area. Most of the conifer and oak stands were established 20 to 110 years ago by natural regeneration (oaks) or planting (pine). Non-forested areas, especially savannas and barrens and upland openings, have declined since 1930 because of tree planting and tree encroachment (natural succession), in conjunction with fire suppression. Age classes greater than 60 years are frequent for two reasons: (1) most individual oak stands were regenerated between 1890 and 1910, and (2) the majority of pines (capable of ages exceeding 200 years) were planted 20 to 70 years ago. The current age class distribution is displayed in Table 3.1, Acres of Forest Types by Age Class 2009, and Figure 3.1, Acres of Forest Type 2009. The vertical structure of forested areas is predominantly even-aged, where dominant trees have similar diameters, heights, and ages in any particular stand. Seedlings and saplings are numerous in younger forested locations, but one canopy layer still predominates over shorter or taller canopy layers.

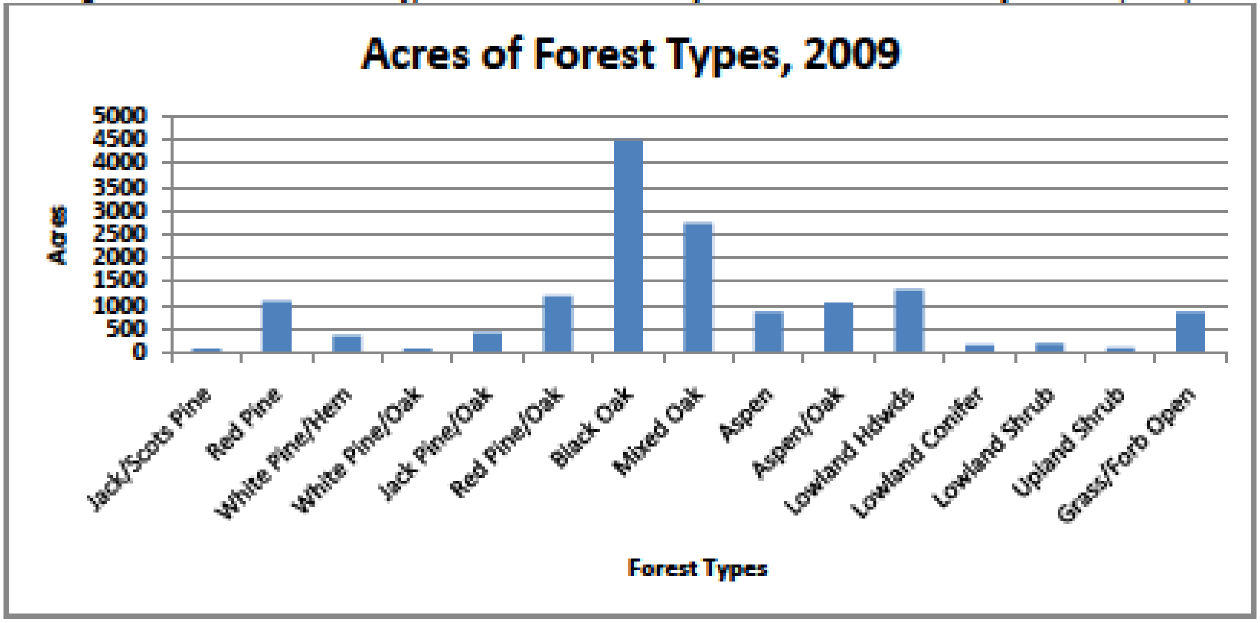
The shrub layer of forested areas is dominated by witch hazel, juneberry, oak and red maple regeneration, and blueberry. A variety of herbaceous species are found in the understory of forested stands. In addition to the dominant and frequent tree species, the understory vegetation of forested stands also includes: hophornbean, hawthorn, jack pine, musclewood, raspberry, blackberry, huckleberry, and maple-leaved viburnum. Herbaceous vegetation in the closed canopy areas is similar to that found in the openings, with fewer occurrences and lower densities of warm season grasses. Species associated with the low-site oak forests may also include: pipsissawa, bear-berry, and toadflax. Oak stands typically are dominated by bracken fern, Pennsylvania sedge, wintergreen, poverty oatgrass, blueberry, and oak seedlings. Some species associated more commonly with oak forests, but not found frequently in the openings, included: pipsissawa, bear-berry, and squawroot. Pennsylvania sedge, bracken fern, and grass species predominate in the non-forested uplands. Various sedge, bullrush, grass, and fern species are common in the non-forested wetland areas.

Table 3.1: Acres of Forest Types by Age Class, 2009 (National Forest System Lands Only)

Forest Type	Group	Age Class: 2009												Total Acres	%
		0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-110+	No Age		
Jack/Scots Pine	1					67	9	11						87	0.6
Red Pine	2			266	64	387	129	173	73					1,092	7.3
White Pine/Hem	2						42	249		34		31		356	2.4
White Pine/Oak	2											86		86	0.6
Jack Pine/Oak	3			76	128	124		100						428	2.9
Red Pine/Oak	3			667	86	77	300			71				1,201	8.0
Black Oak	4			200	103	8		202	224	675	92	2,965		4,469	29.8
Mixed Oak	4		9	32	41			265	205	76	265	1,844		2,737	18.2
Aspen	5		278	99	287	71	16	27	59	22				859	5.7
Aspen/Oak	4		48	417	37	14			363	13	40	123		1,055	7.0
Lowland Hdwds	6		18						13	86	517	697		1,331	8.9
Lowland Conifer	7								10		52	99		161	1.1
Lowland Shrub	8												196	196	1.3
Upland Shrub	8												98	98	0.7
Grass/Forb Open	8												856	856	5.7
	Subtotal	0	353	1,757	746	748	496	1,027	947	977	966	5,845	1,150	15,012	100.0

Acres are rounded from GIS data; minor cover types are combined with associated forest cover types.

Figure 3.1: Acres of Forest Type on National Forest System lands within the Project Area (2009)



Groups of Similar Vegetation

The Forest Plan provides vegetation composition objectives for 2016, based on the natural capability of the land, for the desired amounts of vegetation classes on all Manistee National Forest lands. These amounts are displayed in Table 3.2, Desired, Existing, & Project Area Vegetative Composition Objectives. In comparing these objectives to the existing condition within the Project Area, northern hardwoods (sugar maple, beech, and yellow birch), short and long lived conifers (jack, red and white pines), and aspen/paper birch are under-represented; low and high site oaks (black, white, and northern pin oaks) are over-represented; openings (including managed openings < 10 ac.) and lowland hardwoods and conifers (red maple, green and black ash, and northern white cedar) are adequately represented. Northern hardwoods and aspen are under-represented because of the low soil fertility on the National Forest System lands in the Project Area. Low site oaks, which include areas inter-planted with red pine, and high site oaks, which include areas inter-planted with white pine, are over-represented because the majority of National Forest System lands in the Project Area are well-suited to those species associated with these Vegetative Classes.

For this project, special emphasis is given to barrens and savannas. These are non-forested lands ranging in size from 10 to 200+ acres and having a fire-dependant vegetative community characterized by widely spaced, open-grown trees. Associated understory vegetation is dominated by various herbaceous and shrub species that are dependent on frequent surface fires and are relatively shade intolerant. Barrens and savannas are located on droughty, infertile sandy soils, and were located in Oceana County on outwash plains circa 1815 – 1855. After this period, these areas were converted to agricultural and/or pine and oak forests as the rural population grew within the Project and surrounding areas. Wildfire suppression, beginning in the 1930's, has further allowed oak forests to encroach upon and reduce barrens and savannas to remnants in their previous locations. These remnants are associated with frost-pockets or other areas with sparse tree canopies. Herbaceous plant species associated with savanna/barrens still occur in some of these locations, but Pennsylvania sedge, bracken fern, and non-native species dominate the ground cover. Barrens and savannas are under-represented in the Project Area; however, the soil and climate conditions are suitable for re-establishing this type of Vegetation Class.

Table 3.2: Desired, Existing, & Project Area Vegetative Composition Objectives

Vegetation Class	Forest Plan Desired in 2016	Forest Plan Manistee NF Existing	Project Area National Forest Lands Existing
Short-Lived Conifers	2-8%	5%	3.5%
Long-Lived Conifers	17-23%	21%	18.3%
Lowland Conifers	0-5%	2%	1.1%
Aspen/Paper Birch	10-16%	13%	5.7%
Low-Site Oaks	13-19%	15%	36.6%
High-site Oaks	15-21%	18%	18.2%
Northern Hardwoods	8-14%	11%	0.0%
Lowland Hardwoods	4-10%	7%	8.9%
Openings: Upland and Lowland Brush	4-10%	7%	7.7%
Barrens and Savannas	2-5%	1%	0%

Vegetative Characteristics of Upland Openings

Openings vary in the amount of mature trees, saplings, and shrubs. Generally, the amount of canopy cover is less than 25%, and herbaceous species are predominant but encroachment of woody plant material is a visible trend in many of the openings. Common woody species include bigtooth aspen, black oak, white oak, red pine, white pine, juneberry, black cherry, sand willow, and blueberry. Alleghany plum, a sensitive species, is also found in several locations. Many openings have a high density of Pennsylvania sedge and/or bracken fern that dominate the herbaceous layer and limit the population of other species. Native species commonly found in the Project Area include: big and little bluestem, June grass, common milkweed, hair grass, lupine, frostweed, bushclover, sweetfern, winterberry, bedstraw, flowering spurge, sweet everlasting, wild strawberry, Carolina rose, racemed milkwort, and hawkweeds. Less commonly found native forbs include: hairbell, columbine, lance-leaved coreopsis, blazing star, wild bergamot, goat's rue, Indian grass, cudweed, asters, Virginia wild rye, hoary puccoon, rice grass, jointweed, spreading dogbane, goldenrods, butterfly weed, fleabane, black-eyed susan, poverty oatgrass, woodland sunflower, self heal, poke milkweed, tick trefoil, perennial rye, several clubmosses, cats-ear, pussytoes, birdsfoot violet, bunchberry, Canadian lousewort, speedwell, Virginia dwarf dandelion, Houstonia, and the sensitive species Hill's thistle and purple milkweed. Non-native invasive species consist largely of St. Johnswort, hoary alyssum, spotted knapweed, smooth brome, white sweet clover, reed canary grass, orchard grass, burdock, yellow rocket, autumn olive, Tartarian honeysuckle, and leafy or cypress spurge.

(3.3b) Area of Analysis

The area of analysis for the direct and indirect effects on forest vegetation is the National Forest System lands where treatments will occur, and adjacent National Forest and private lands within ½ mile of treatment sites. The area of analysis for the cumulative effects on all vegetation is the Manistee National Forest (including State of Michigan and private lands) within its proclaimed boundary. This large area represents where manipulation of similar forest ecosystems, in response to market and non-market forces, affects current and future forest vegetation patterns.

(3.3c) Direct and Indirect Effects

Cover Types, Age Classes, and Species

Alternative 1: Individual tree growth, survival, and stand dynamics (succession), would be subject to environmental and biological factors. The longer-lived upland species (oaks and pines), would tend to persist as even-aged groups and white pine would increase in the understory of many of these locations. Upland aspen and aspen-oak stands would trend towards uneven-aged oak and pine forests as individuals or small groups of aspen trees decline and die out. Riparian forests would continue to become un-even aged, as wind, flood events, and insect and disease generate opportunities for red maple, white pine and hemlock to become more widely established. The population of red maple would increase in aspen stands greater than age 80, especially in areas influenced by water tables; red maple would also increase in the understory of many oak stands located on moderately and highly productive soils. Aspen stands would be represented by a smaller range of age classes, with ages greater than 80 years converting to lowland hardwoods or mixed oaks, and age classes of 70-79 having progressively fewer mature aspen trees. Low and high-site oak stands would remain the most common forest types, and the oldest age classes (between 90 and 120 years) would still be the most frequent (USDA-Forest Service 1990).

Upland openings (< 10 acres in size) would likely decrease in both size and abundance due to encroachment by oaks and pines. This would also occasionally be influenced by natural disturbances that would promote open habitats. The dominant shrub species (black cherry, witchhazel, juneberry, and blueberry) would persist. Herbaceous ground cover would continue to be dominated by Pennsylvania sedge and bracken fern. Lowland openings would remain relatively constant in both size and abundance. These openings, because of high water tables, existing drainage patterns, infrequent fires, and windstorms, would favor willow, alder and dogwood shrubs, cattails, and carex and bulrush species. The projected age class distribution by forest type is displayed in Table 3.3, Alternative 1: Projected Acres of Forest Types by Age Class, 2019, and Chart 3.2, Alternative 1: Projected Acres of Forest Types, 2019.

There are three vegetation treatments active in the Project Area that were analyzed previously and which are on-going within the Project Area.

1. Approximately 50 acres in Greenwood Township will be converted from plantation red pine to an upland opening; supplemental treatments include prescribed fire, seeding, and planting to restore barren and savanna conditions.

2. Approximately 78 acres in Greenwood Township have been converted from red pine and oak to upland openings to evaluate the effects of varying combinations of mechanical and prescribed fire treatments on herbaceous and nectar species.
3. Approximately 346 acres in other upland opening locations within the Project Area will be treated between 2009 and 2011 to maintain open conditions and improve herbaceous diversity.

The on-going treatments are expected to provide barrens/savanna vegetation conditions by 2019.

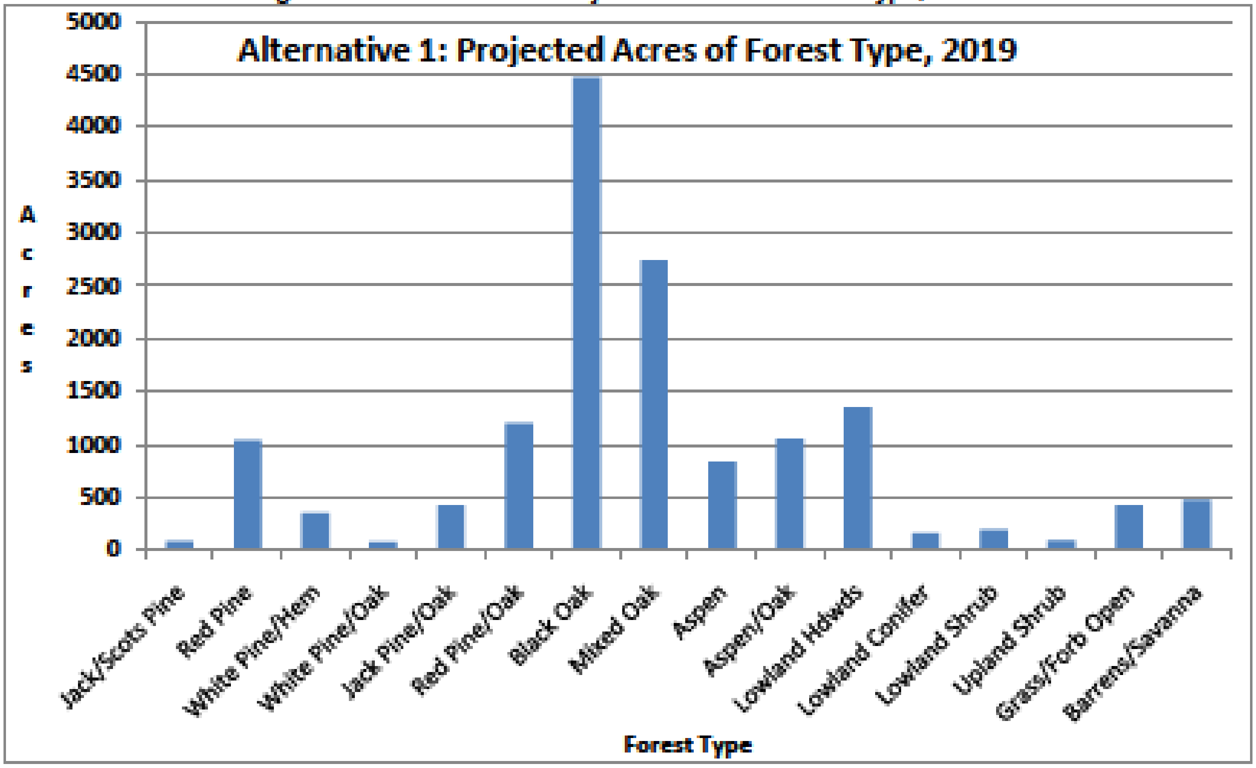
Table 3.3 (Projected Acres of Forest Types by Age Class, 2019) and Figure 3.2 (Projected Acres of Forest Type, 2019) reflects how these three active treatments affect forest cover types.

Table 3.3: Alternative 1: Projected Acres of Forest Types by Age Class, 2019
(National Forest System Lands Only)

Forest Type	Age Class: 2019												Total Acres	%
	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-110+	No Age		
Jack/Scots Pine						67	9	11					87	0.6
Red Pine				266	64	387	129	173	23				1,042	6.9
White Pine/Hem							42	249		34	31		356	2.4
White Pine/Oak											86		86	0.6
Jack Pine/Oak				76	128	124		100					428	2.9
Red Pine/Oak				667	86	77	300			71			1,201	8.0
Black Oak				200	103	8		202	224	675	3,057		4,469	29.8
Mixed Oak			9	32	41			265	205	76	2,109		2,737	18.2
Aspen			278	99	287	71	16	27	59				837	5.6
Aspen/Oak			48	417	37	14			363	13	163		1,055	7.0
Lowland Hdwds	22		18						13	86	1,214		1,353	9.0
Lowland Conifer									10		151		161	1.1
Lowland Shrub												196	196	1.3
Upland Shrub												98	98	0.7
Grass/Forb Open												432	432	2.9
Barrens/Savanna												474	474	3.2
Subtotal	**22**	**0**	**353**	**1,757**	**746**	**748**	**496**	**1,027**	**897**	**955**	**6,811**	**1,200**	**15,012**	**100.0**

Acres are rounded from GIS data; minor cover types are combined with associated forest cover types.

Figure 3.2: Alternative 1: Projected Acres of Forest Type, 2019



Alternatives 2 and 3: In non-harvest areas, individual tree growth and survival, and stand succession, would be subject to environmental and biological factors. The longer-lived species (oaks, maples, pines), would tend to persist as even-aged groups. This is in contrast to aspen stands, which would trend towards uneven-age maple and oak forests as the aspen trees decline and die out. The population of red and white pine and oak species in large tree sizes would remain relatively stable. There would be increases in small size trees of these species in the areas where aspen trees are in decline. The population of red maple would increase in aspen stands greater than age 80, especially in areas of high water tables. Red maple would also increase in the understory of many oak stands with ELTP's of 20-24. Aspen stands would be represented by a smaller range of age classes, with ages greater than 80 years areas converting to lowland hardwoods or mixed oaks. Aspen age-classes of 70-79 would have progressively fewer mature aspen trees; however, aspen would increase in the 0-9 year age class, as commercially and non-commercially treated stands regenerate.

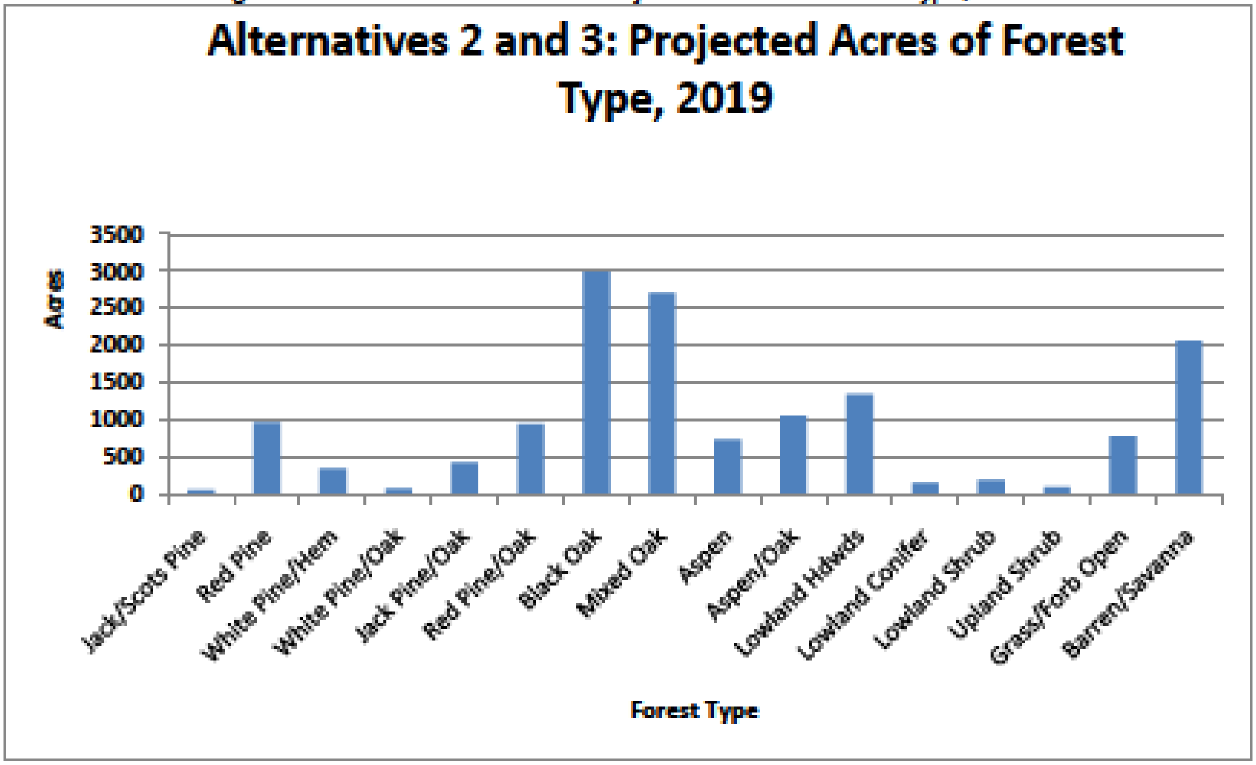
The acres of barrens would increase, as oak forests are converted to this cover type. Some upland openings (< 10 acres in size) would naturally convert to pines and oaks as efforts to remove encroaching woody stems decline. Low and high-site oak stands would remain the most numerous. The oldest age classes (between 90 and 110 years) would still be the most frequent (USDA-Forest Service, 1990). The dominant shrub species (viburnum, witchhazel, juneberry spp.) would persist, with little opportunity for early seral species (rubus and prunus species) to become established. Lowland openings would remain relatively constant in both size and abundance. This would be due primarily to the high water tables, existing drainage patterns, infrequent fires and windstorms, which would favor willow, alder and dogwood shrubs and cattails, carex, and bulrush species. Table 3.4 and Figure 3.3 display Projected Acres of Forest Types by Age Class for Alternatives 2 and 3.

Table 3.4: Alternatives 2 and 3: Projected Acres of Forest Types by Age Class, 2019
(National Forest System Lands Only)

Forest Type	Alternatives 2 and 3: Age Class: 2019												Total Acres	%
	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-110+	No Age		
Jack/Scots Pine						48	0	11					59	0.4
Red Pine				266	64	364	81	173	23				971	6.5
White Pine/Hem							42	249		34	31		356	2.4
White Pine/Oak											86		86	0.6
Jack Pine/Oak				76	128	124		100					428	2.9
Red Pine/Oak				518	86	77	271						952	6.3
Black Oak				100	103			67	166	425	2,129		2,990	19.9
Mixed Oak	26		9	32	39			265	205	76	2,087		2,739	18.2
Aspen			242	83	248	71	16	27					687	4.6
Aspen/Oak	50		48	417	37	14			313	13	163		1,055	7.0
Lowland Hdwds	47		18						13	86	1,214		1,378	9.2
Lowland Conifer									10		151		161	1.1
Lowland Shrub												196	196	1.3
Upland Shrub												98	98	0.7
Grass/Forb Open												788	788	5.2
Barren/Savanna												2,068	2,068	13.8
Subtotal	**123**	**0**	**317**	**1,492**	**705**	**698**	**410**	**892**	**730**	**634**	**5,861**	**3,150**	**15,012**	**100**

Acres are rounded from GIS data; minor cover types are combined with associated forest cover types.

Figure 3.3: Alternatives 2 and 3: Projected Acres of Forest Type, 2019



Principal Effects on Other Resources

Alternative 1: No new areas would be restored to savanna or barrens cover types. Except for the three areas within the Project Area where treatments are already occurring; Pennsylvania sedge and bracken fern would dominate the herbaceous layer, and suppress the remnant herbaceous component. Within the active treatment areas, the woody overstory (tree) and understory (shrub/sapling) will be reduced to an average of 5-20% and 10-25%, respectively. In these areas, wild lupine and a variety of nectar producing and savanna species will be established by planting or seeding, and non-native invasive species (NNIS) will be reduced. The three active treatments to restore savanna/barrens are approximately 559 acres in size, in 70 locations. Attaining the desired condition on these locations is expected to take ten years.

Wildlife habitats would continue a general trend from mid-seral to late-seral forest cover types. This would be accompanied by a declining amount of upland open habitat due to natural succession. Aquatic habitats would continue to be impacted by the delivery of sediment related to road crossings. Small increases of woody debris` would accrue in the waterways due to the contributions of declining large trees adjacent to riparian channels. Riparian vegetation along the North, South, and Main Branches of the White River, along with Sand and Knutson Creeks would continue to be affected by natural and human caused water level fluctuations. Exposed shorelines and eroding banks would recruit woody debris at naturally occurring rates, influencing the rate of re-vegetation by both early and late seral vegetation stages.

Forest roads would be open to non-commercial vehicle use, especially high clearance vehicles, on all locations and road segments that are not closed to motor vehicles; County roads would be open to all licensed vehicles. Vehicle use on these roads during periods of wet weather or spring thaws would result in rutting and road widening, both of which damage the roots of adjacent trees and shrubs. Non-stabilized roadbeds would be a source of sediment deposited onto herbaceous and young woody vegetation. Some roads service historic illegal trash dumping sites and, by remaining open, would result in future trash dumping. Many illegal trash dumping sites are also sites of NNIS introduction through yard waste and from the seeds that are carried to the site on the vehicles used while dumping. The existing transportation system would not be altered, and would continue to provide vectors for the spread or introduction of NNIS species within the Project Area and between the Project Area and other public and private lands. Areas open to firewood gathering from National Forest System lands would not be changed within the Project Area. Within the WRSNA, gathering is restricted to local, subsistence (camp site use) only, and east of the North Branch of the White River and north of the Pine Point access road, gathering is regulated through the firewood permit system.

Recreation use along County and open Forest Service roads, at dispersed camping sites, and on Forest Service roads closed to motor vehicle use would result in further removal and damage to stems and roots of vegetation in both upland and riparian zones adjacent to these roads and sites. The impacts to level areas, attractive for vehicle and camper use, would likely increase over time. The locations of habitat disturbance associated with non-designated camping, equestrian and pack animals, and motor vehicle use would continue to provide disturbed habitat areas for NNIS to colonize, spread, and continue to be introduced.

Fuels reduction and air quality would not be affected by prescribed fire and mechanical equipment treatments beyond the 343 acres of broadcast and pile burning that are associated with the projects already approved by previous decisions within the Project Area. These treatments would generate particulate matter and cause a short-term decline to local air quality. Additional air quality impacts would be caused by various point and non-point sources, such as local emissions (e.g., automobile exhaust, residential wood burning) and non-local emissions (e.g., regional transport of ozone).

Alternatives 2 and 3: Large areas of oak, oak-aspen, and oak-pine forest would be restored to savanna/barrens cover types using mechanical equipment to reduce overstory canopy cover to 10–25% over 70–80% of each area, and 25–60% canopy cover over the remaining 20–30% of each area. White, black and northern pin oaks, and red and white pines would continue to dominate the overstory in these locations, accompanied by sprouts of oak and pin cherry and natural regeneration of pines. Pennsylvania sedge and bracken fern would be the dominant herbaceous species in these areas immediately afterwards. Subsequently, one or two mechanical, hand tool, or broadcast/pile burning prescribed fire treatments to reduce woody stem density (including oak and cherry sprouting) to an average of < 25% cover, would occur on these same locations. Herbicides (see Appendix C) using ground-based application methods at recommended label rates to suppress oak and cherry sprouting, carex, and bracken fern, would be used to supplement mechanical, hand tool, and broadcast/pile burning treatments to attain the desired canopy conditions. The locations proposed for these treatments surround, or are immediately adjacent to occupied KBB habitat. In addition, these locations have proportionately small amounts of understory black and white oaks than other forested locations in the Project Area, providing a more effective and efficient opportunity to restore savanna/barrens than in closed canopy oak forests and plantations having greater numbers of seedlings. Brudvig and

Asbjornsen (2009) found that woody encroachment removal is an important step in restoring Midwestern oak savannas because of the role that mechanical and prescribed fire treatments play in the reestablishment and maintenance of soil moisture gradients. The forested areas proposed for conversion to non-forest areas are generally past an age for which the culmination of mean annual increment (ft^3/ac/year) is achieved for low-site oaks (e.g., 100 years). Exceptions to the harvest of trees prior to attaining culmination of mean annual increment are permitted in deference to achieving other Forest priorities (creation of KBB habitat). The Forest Plan allows for forested areas to be converted to non-forest to provide KBB habitat within all locations proposed for such treatment.

Numerous red pine and red pine/oak plantations are proposed for mechanical thinning treatment. A few of these plantations are also proposed for hazardous fuels reduction using broadcast/pile burning treatments after the thinnings are completed. The thinnings would retain approximately 80% canopy cover dominated by pines and hardwoods of various sizes. This would be sufficient to continue the desired growth rates for another 10–20 years. Thinning treatments would continue even-age management, promoting progressively larger diameter trees in the overstory, while allowing for the development of a native understory and herbaceous layers representative of maturing conifer and oak forests. Prescribed fire treatments would enhance this canopy structure through the reduction of surface fuels (slash) and the top kill of the smaller woody stems. An acceptable range of fire intensity for the fuel types within the Project Area would be 25-200 BTU/ft/sec. Within this intensity range, heat- induced tree mortality would occur on approximately 5–10% of live trees < 8" in diameter.

Two locations of mature oak/aspen forest are proposed for treatment, using mechanical equipment to clearcut and regenerate these areas by root and stump sprouting. The understory components at these locations consist of red maple, white pine, and small oaks. The purpose of the treatments is to retain aspen within the Project Area in locations that are not likely to encroach upon potential or occupied KBB habitat. Treatments would promote an even-age structure, comprised of big-tooth aspen and white and black oaks. The understory in these areas would be sparse for the next 10–20 years, and the herbaceous layer would be dominated by bracken fern, blueberry, and Pennsylvania sedge. The two areas proposed for regeneration are over 70 years of age, and have attained culmination of mean annual increment (ft^3/ac/year). Clearcutting has been determined to be the optimum method to regenerate aspen, and is appropriate to meet the objectives and requirements of the Forest Plan.

All proposed thinnings, clearcuts, and savanna restoration treatments would be completed using commercial and/or non-commercial treatments. Locations having sufficient quantities of timber products desired by the forest product industry would be harvested under a series of contracts prepared and supervised by the Forest Service. These contracts are anticipated to be initiated and completed over the next 10–15 years, and take into consideration market demand for conifer and oak forest products, local Forest Service appropriations to prepare areas for sale, coordination of access for large trucks among sale locations, and seasonal restrictions to protect KBB populations and provide for recreational uses. Non-commercial treatments (seedbed preparation, seeding, small woody stem removal and herbicide application) for savanna and KBB habitat restoration, including those locations with insufficient quantities of timber products, would also occur over the next 10–15 years, and use either Forest Service personnel or contract labor sources. Prescribed fire treatments would also occur over the next 10–15 years, and use Forest Service personnel to plan, conduct, and monitor these activities. Non-commercial and prescribed fire treatments would generally occur when large tree density is sufficiently reduced to proceed with activities that further develop desired forest, savanna and KBB habitat conditions; all subsequent treatments are also subject to local Forest Service appropriations and seasonal restrictions to protect KBB populations and provide for recreational uses.

Aspen would be regenerated in stands selected for treatment, with a desired density of > 2,400 stems/acre at age three. The amount of non-forest habitat would be almost doubled, while other openings would be treated to remove encroaching oaks and pines. Aquatic habitats would receive reduced levels of sediment associated with road crossings. Benefits from small increases of in-stream woody debris would occur, contributed by declining large trees adjacent to riparian channels and the addition of woody materials associated with fish structures. Riparian vegetation along the North, South, and Main Branches of the White River and Sand and Knutson Creeks would continue to be affected by natural and human caused water level fluctuations. Exposed shorelines and eroding banks would recruit woody debris at naturally occurring rates, influencing the rate of re-vegetation by both early and late seral vegetation stages.

Dead and down woody material would be partially or wholly consumed during the prescribed burning operations. Some of the dead standing trees would also be partially or wholly consumed. The structural integrity would be compromised for those that remain standing. Increased tree mortality would also occur as a result of the burning activities. This would be most pronounced in the younger age classes (0-20yr), where the tree canopies are in closer proximity to the fire front, the rooting systems are shallower and not as well established, and the outer bark surfaces are not fully developed. The level of mortality would be dependent on the age-class, species composition, and fire intensity. In areas being converted to savanna, the timing and distribution of the burning would occur to promote increased levels of fire intensity. This would cause an increase in tree mortality across all age-classes. Slash from the harvesting operations would be consumed and used as a means of carrying the fire through the burn units. Fire intensities would decrease with successive burns, as the woody material available for consumption becomes less and the fuel type slowly shifts from forested to a grassland mosaic.

Where prescribed burning would occur outside of the savanna creation areas, the timing and distribution would promote decreased levels of fire intensity. In these areas, the effects would be limited primarily to the understory. Most of the dead and down material would be consumed, with mortality limited to the younger age-classes. Through successive burns, fuel loadings would be reduced and forest types in these areas would be dominated by the more fire-tolerant species (i.e. oak). Fire scarring would be evident on the older age-class trees.

Under Alternatives 2 and 3, County roads would continue to allow licensed motor vehicles throughout the Project Area. Forest roads within the WRSNA would be closed to motor vehicles except for administrative uses. Under Alternative 3, one location in Otto Township would be seasonally closed to public motor vehicle use. Vehicle use during periods of wet weather or spring thaws on the roads remaining open to the public would result in the continued damage to the roots of trees and shrubs and promote increased levels of rutting and road widening in areas where the surface and sub-surface soils are saturated. Un-stabilized roadbeds would continue to be a source of sediment deposited onto herbaceous and young woody vegetation; however, as closed roads become re-vegetated, less of this damage would occur. Vehicles avoiding natural obstacles on open roads would continue to increase the width of roadbeds, damaging the stems and roots of plants. Fewer roads would decrease the opportunity for illegal trash dumping and reduce the local spread and introduction of NNIS. The decreased road density in the Project Area would also reduce the number of available vectors for spread of NNIS species within the Project Area, and between the Project Area and other public and private lands. Areas open to firewood gathering from National Forest lands would not be changed within the Project Area: within the WRSNA, gathering is restricted to local, subsistence (camp site use) only, and east of the North Branch of the White River and north of the Pine Point access road, gathering is regulated through the firewood permit system.

Dispersed recreation along County and open Forest roads, especially adjacent to campsites and parking areas, would result in further removal and damage to stems and roots of vegetation. Under Alternatives 2 and 3, the roadbeds associated with the proposed road closures within the WRSNA would begin to naturally re-vegetate. Where adjacent to savanna restoration activities, roads identified as not needed for administrative purposes would be incorporated into the treatment areas and would receive a similar suite of restoration treatments. Designated camping sites, with clearing perimeters established, would reduce the ad-hoc effects of vegetation damage of indiscriminate campsite selection and modification. Overall, lower road densities would provide fewer areas where NNIS plant species are most easily established, and reduce overall NNIS treatment costs.

Under Alternative 2, there would be no access restrictions for non-motorized recreation within the WRSNA, with the exception of horse use. Within the boundaries of the WRSNA, horses would be limited to the designated non-motorized trail system and the associated facilities. As a result, the impacts from horse use on the vegetation within the Project Area under Alternative 2 would be limited to those areas that are part of, or adjacent to, the non-motorized trail system. The channeling of horse traffic to a designated trail would cause increased compaction and rutting on and adjacent to the designated trail. With increased use in these areas, the root systems of the existing woody vegetation would gradually become exposed and damaged, making the trees more susceptible to disease and windthrow. These effects would be the most pronounced on the eastern portion of the trail (adjacent to the river) and on the areas of the trail that do not occur on roads (new construction), as the existing roadbeds are typically already compacted and void of existing woody vegetation. Pronounced effects to the vegetation would be evident on the slopes and on areas where horse use occurs adjacent to the White River. Currently, the largest visual impact to the vegetation within the Project Area related to horse use is related to the damage that is associated with vehicles (parking) and camping (tethering). While this type of damage would be reduced under Alternative 2, there would be a trade-off associated with the increased damage to the vegetation caused by concentrating the horse use to one designated trail.

Under Alternative 3, there would be no access restrictions for non-motorized recreation within the WRSNA, again with the exception of horse use. There would no horses allowed within the boundaries of the WRSNA and no facilities would be provided to facilitate that form of recreational use. As a result, in comparison to Alternatives 1 and 2, there would be reduced direct and indirect effects to the woody vegetation within the boundaries of the WRSNA. This would be most evident along the South Branch of the White River, which now receives horse use and which would be part of the designated route under Alternative 2. Due to the soil typing and the slopes in this area, the vegetation in this area is especially susceptible to the effects of compaction and erosion. With no horses allowed in this area, rutting and the associated damage to the tree root systems would be reduced.

Fuels reduction and air quality would be affected by additional prescribed fire and mechanical equipment treatments beyond the 343 acres of broadcast and pile burning previously approved in the Savanna/Barrens Restoration Project. The proposed additional treatments and ongoing treatments would generate particulate matter and cause a short-term decline to local air quality; additional air quality impacts would be caused by various point and non-point sources, such as local emissions, e.g., automobile exhaust, residential wood burning, and non-local emissions, e.g., regional transport of ozone.

(3.3d) Cumulative Effects

District records show that a variety of vegetation treatments have occurred on National Forest System lands within the Project Area between 1978 and 2009. These treatments are summarized in Table 3.5, Project Area Vegetation Treatments 1978–2009. The remaining acres of tree and shrub cutting from the three on-going projects within the Project Area (~396 acres), prescribed fire (~128 acres), and seeding and planting (~559 acres) are included in Table 3.5.

Table 3.5: Project Area Vegetation Treatments 1978 – 2010 (National Forest System Lands Only)

Treatment Types	Forested	Non-Forest, All	Aquatic
Thin and Timber Stand Improvement	794	N/A	N/A
Regenerate by Clearcut/Removal	1,826	N/A	N/A
Regenerate by Shelterwood	294	N/A	N/A
Reduce Encroaching Trees by Hand Tools, Mowing, Prescribed Fire, or Improve by Seeding, Tilling, and Planting	941	713	N/A
Stabilize Stream Banks, Placement of Woody Debris, Install Habitat Structures	N/A	N/A	208
Ongoing Vegetation Treatments	N/A	1,083	N/A

Appendix D of the Forest Plan, Proposed and Probable Practices, displays an estimate of proposed and probable silvicultural treatments for the period 2006 – 2026 in Tables D-4 and D-5. These projections have cumulative effects on the Forests' vegetation composition objectives over the next decade. Large areas of the National Forest would not be subject to active vegetation management. Together with the combined acres of projected thinning, regeneration harvests and conversion of forests to non-forest cover types, a desired vegetation composition (as displayed in Table II-3, pg. II-7 of the Forest Plan) is projected for 2016.

Alternative 1: In unmanaged forests, there would be slow accumulation of late seral forests dominated by the natural vegetation (trees, shrubs, and herbaceous species) associated with the site-specific ELTPs. There would be a trend toward uneven-aged forest structure in those locations not regenerated or maintained for non-forest cover types. Longer-lived species, such as oaks, white pine, and maples would dominant throughout the Project Area, while the number of short-lived species, such as northern pin oak, jack pine, and aspen would decrease. Areas dominated by red and white pines would retain even-age canopy structure, and reach mid- to late-seral stages of development. Jack pine and aspen areas would mature and begin to convert to early seral oak, maple, and conifer forests. Forest areas actively managed would be regenerated, primarily using even-age methods, for oaks, aspen, and pines. The dominant shrub and herbaceous species representative of site-specific ELTPs would persist, but would not be as common as in unmanaged forests. Because of the three projects that are already occurring within the Project Area, the amount of red pine and low-site oaks are expected to decrease as a result of conversion to non-forested upland openings, including barrens/savanna. Lowland hardwoods would increase as the aspen cover type declines within riparian zones through natural succession. The other forest vegetation groups would remain at current levels or fluctuate slightly, as they are still in age classes where natural conversion to other species would not be likely during this planning period. This projection excludes unpredicted occurrences such as windstorms and wildfires that affect stand level species' composition. The amount of pine thinnings, mature forest regeneration, and dead tree salvage treatments, including firewood gathering, are projected to decline from levels achieved over the past 20 years.

Infrequent insect, fire, and wind-induced mortality events would interact with other natural processes, and result in early seral forest structure and species composition only at a local scale (one to several acres, and less frequently, at scales larger than 10 acres). Lowland and riparian forests would be especially susceptible to these events. The population of ash species is likely to severely decline because of the spread of the emerald ash borer, which kills white, green and black ash trees within a few years of becoming infested. The population of American beech trees with diameters greater than 12" is likely to decline, although at a lower rate than the ash species, because of the spread of beech bark disease, which leads to mortality within 15+ years of becoming infested.

Pines and oaks would encroach on non-forested upland areas, where not actively managed. Gradually, as these species mature and continue to regenerate, the openings would become forested. The long-term exclusion of fire disturbance would enhance these effects, and would favor an increased presence of those species tolerant of less frequent fires (maples and small diameter oaks and pines, and representative ELTP shrub and herbaceous species) over those species adapted to more frequent fire events (large diameter oaks and pines and herbaceous species such as lupine and bluestem and coreopsis species). The amount and acreage of small upland openings, within areas dominated by low-site oaks and jack pine, would decline as they are incorporated into savanna/barrens habitat; however, managed upland openings and natural un-managed openings (e.g. shrub wetlands) will frequently be found intermixed within areas dominated by longer lived oaks, pines and maples.

The vegetation composition projected in 2019 for the Project Area and the desired vegetative type composition on the Manistee National Forest in 2016 is displayed in Table 3.6, Alternative 1: Change in Vegetation Class Composition. This table reflects the three on-going projects within the Project Area. The projected amounts of forest vegetation treatments (including prescribed fire) to establish savanna/barrens on National Forest System lands could amount to approximately 20,000 acres in the next few decades. Proportionately within the Project Area, this could be 5,000+ acres. Therefore, beyond 2016, oak, pine, and aspen cover types would decline in other areas of the Manistee National Forest as these cover types are converted to savanna/barrens. In addition, prescribed fire to maintain these savanna/barrens would be used on a fraction of these acres annually.

Table 3.6: Alternative 1: Change in Vegetative Class Composition

Vegetation Class	Forests' Plan Desired in 2016	Project Area 2019	Net % Change From 2009 to 2019
Aspen – Birch	10-16%	5.6 %	-0.1%
Short-Lived Conifers	2-8%	3.5%	0
Long-Lived Conifers	17-23%	17.8%	-0.6%
High Site Oaks and Northern Hardwoods	23-35%	18.2%	0
Low Site Oaks	13-19%	36.8%	+0.2%
Lowland Hardwoods and Conifers	4-15%	10%	+0.1%
Upland and Lowland Openings	4-10%	4.9%	-2.8%
Barrens and Savannas	2-5%	3.2%	+3.2%

Landscape conditions on National Forest System lands would progress subject to the effects of non-native species on the native species. Development of private lands, especially adjacent to primary/secondary county roads, will further alter the natural landscape and become more apparent with increasing population growth and density (USDA 2007), and attendant increase for recreation access on National Forest lands.

Private lands within the Project Area are likely to be harvested for forest products, although at levels less than in the past. The most common activity would be the removal of trees > 11" in diameter and dead tree salvage harvesting. New residential and commercial building would continue to reduce the amount of total forest cover in nearly all privately owned lands immediately adjacent to National Forest lands as housing density is projected to exceed 65 units/mi^2 by 2030 (Ibid). Many private parcels are used for recreation, including ORV and horse riding, and hunting for game species. Private lands within and adjacent to the Forest boundary are also used for agriculture (cropping, pasture, orchards, Christmas trees, etc.). While the type of operation influences the type and amount vegetation present on these parcels, trends indicate that the larger parcels will continue to be sub-divided for development. These trends will not only lead to shifts in the existing land use on these parcels, but also on the amount of open space available on private lands within and adjacent to the Manistee National Forest boundary.

There are no active oil and gas exploration sites within the Project Area. The highest potential for oil and gas resources is associated with Pinnacle Reef exploration, which is located northwest of the Project Area. The subsurface rights on National Forest lands are owned by the U.S.A., State of Michigan, or private interests. Numerous oil and gas exploratory wells established in the past on National Forest lands are plugged and inactive. Two authorized oil/gas leases exist within the Project Area (Otto Township, sections 11, 12, and 27). Federal oil and gas leases will contain a notice that precludes surface occupancy and road construction in occupied Karner blue butterfly areas; leases will also include notice that occupancy is subject to more restrictive controls than in metapopulation areas. These leases also restrict surface occupancy and use to comply with the Forest Plan Standards and Guidelines within the WRSNA and Study Wild and Scenic River corridor. No common use variety minerals are authorized within the Project Area on National Forest lands. There are active and inactive common use variety minerals (e.g., sand and gravel pits) on private lands in northern Greenwood township.

Conclusion: The duration and magnitude of no action will incrementally add to past, present, and reasonably foreseeable forest vegetation patterns within the Manistee National Forest, primarily by fostering late seral forest conditions in mature upland oak and conifer forests, and allowing immature aspen and conifer forests to mature or be replaced by mid-seral stages of oaks, maples, and conifers within the Project Area. Upland conifers and low-site oaks would likely be converted to barrens/savanna cover types elsewhere on LTA 1 within the Forest. This effect will be most pronounced on National Forest System lands. Private lands are expected to shift towards building site development and recreational uses, woodlands, and upland open uses, (e.g., unimproved pasture and game species habitat improvement).

Alternatives 2 and 3: The cumulative effects would differ from Alternative 1 principally by converting short and long-lived conifers and low-site oak cover types to non-forested cover types. The treatments proposed would change the age-class structure and species composition in individual forested stands from even-aged to non-forested canopies, the shrub and herbaceous layers would initially be dominated by oak and cherry sprouts, Pennsylvania sedge, and bracken fern. Within 10 years, a more diverse herbaceous layer and fewer tree and shrub sprouts will provide a barrens/savanna cover type within the Project Area.

Outside of the Project Area, the other cumulative effects would be similar to those described above in Alternative 1, except that fewer acres of the barren/savanna cover type would be created elsewhere on LTA 1 within the Manistee National Forest.

The projected amounts of forest vegetation treatments (including prescribed fire) to establish savanna/barrens on National Forest System lands could amount to approximately 20,000 acres in the next few decades. Proportionately within the Project Area, this could be 5,000+ acres. Therefore, beyond 2016, oak, pine, and aspen cover types would decline less in other areas of the Manistee National Forest as these cover types are converted to savanna/barrens within the Project Area. In addition, prescribed fire to maintain these savanna/barrens would be used on a fraction of these acres annually.

Table 3.7 displays the projected changes in the composition of vegetation types associated with Alternatives 2 and 3; this table reflects the three active treatments in the Project Area.

Table 3.7: Alternatives 2 and 3: Change in Vegetative Type Composition from 2009

Vegetation Class	Forests' Plan Desired in 2016	Alternatives 2 and 3 % of Project Area 2019	Alternatives 2 and 3 Net % Change From 2009 to 2019
Aspen – Birch	10-16%	4.6 %	-1.1%
Short-Lived Conifers	2-8%	3.3%	-0.2%
Long-Lived Conifers	17-23%	15.8%	-2.5%
High Site Oaks and Northern Hardwoods	23-35%	18.2%	0
Low Site Oaks	13-19%	26.8%	-9.8%
Lowland Hardwoods and Conifers	4-15%	10.3%	+0.3%
Upland and Lowland Openings	4-10%	7.2%	-0.5%
Barrens and Savannas	2-5%	13.8%	+13.8%

Conclusion: The duration and magnitude of Alternatives 2 and 3 would incrementally add to past, present and reasonably foreseeable forest vegetation patterns within the Manistee National Forest. This would occur primarily by converting upland conifer and low-site oak cover types to barrens/savanna cover types within the Project Area. Across the rest of the Forest, existing late-seral stages of forest vegetation would become interspersed with early-seral stages of aspen and non-forest areas. This effect would be most pronounced on National Forest System lands. Private lands are expected to shift towards building site development and recreational uses, woodlands, and upland open uses (e.g., unimproved pasture and game species habitat improvement). The amount of non-forest cover types on both federal and private lands will increase, but herbaceous species favorable to Karner Blue butterfly are not likely to increase proportionately on private lands.

(3.4) Herbaceous Vegetation

(3.4a) Existing Condition and Resource-Specific Information

Savanna and Karner Blue Butterfly Plant Species and Existing Conditions

Historically, approximately 10 percent (or 60,000 acres) of the Manistee National Forest was made up of some type of savanna system (HMNF Programmatic Biological Evaluation 2005). Fire was the major disturbance factor influencing the creation and maintenance of these systems, with the most open areas likely burning in successive years (Corner pers. comm. 2003c.f.; USDA Forest Service 2005). In an unaltered condition, savannas support a diverse flora including numerous species that are characteristic of dry prairies. A number of plant and animal species were reduced in frequency of occurrence and density as these communities became closed canopy forests (VandeWater 2004). The savanna ecosystem is now considered rare throughout its historic range in Michigan, with the majority having either been destroyed through land conversion or altered as a result of plant succession (Chapman, et al. 1995).

The current condition of most remaining savanna habitat in Michigan is highly degraded. Even in areas where structural characteristics may be similar to savanna conditions, species composition is highly variable and often not reflective of native floral conditions. Non-native invasive plant species (NNIS) such as spotted knapweed (*Centaurea maculosa)*, St. Johnswort (*Hypericum perforatum)*, leafy spurge (*Euphorbia esula*), Canada thistle (*Cirsium arvense*), white clover (*Melilotus alba*), yellow sweet clover (*Melilotus officinalis*), and smooth brome (*Bromus inermis*) have become well-established and are commonplace. These species can compete with native flora and have proven difficult to eradicate in other restoration efforts (VandeWater 2004).

Within the Project Area, native savanna flora generally occur as a small component of the overall floral in the understory of existing forested stands and as remnant patches within existing openings. Pennsylvania sedge (*Carex pensylvanica)* often dominates the herbaceous layer and is a barrier to the establishment of more diverse floral composition. In the absence of fire, Pennsylvania sedge has become well-established in many areas. This has created a monotypic thick mat that is difficult to eliminate even after fire is reintroduced to the ecosystem (VandeWater 2004).

To restore oak savannas to the Midwestern landscape, restoration efforts frequently target encroached remnants by first mechanically removing encroaching woody vegetation and later re-establishing an understory fire regime (Brudvig and Asbjornsen 2009, Packard 1997). Successful restoration depends on a careful assessment of the existing vegetation in a remnant and a careful adaptive management approach to analyzing the results of each progressive restoration action applied (Packard 1997).

The herbaceous layer is a critical element of savanna ecosystems, especially in providing nectar and food support for the insect community and the Karner blue butterfly. The presence of certain plants (e.g. "conservative" plant species found almost exclusively in this type of ecosystem) can indicate where such ecosystems were located in the past. Also, looking at current herbaceous vegetative composition can indicate the general presence or absence of desired savanna plant species' seeds in the soil seedbank. This likelihood may reflect the ease or difficulty in restoring this plant community type.

Botanical surveys were conducted within all of the stands within the Project Area being considered for any type of management activity. Areas being considered for savanna restoration activities were analyzed for the presence of savanna plants, the presence or absence of lupine, the number of 1st and 2nd flight nectar plants utilized by Karner blue butterfly, and the Floristic Quality Index (FQI). The FQI is used to assess the quality of remnant habitats and is based upon the species richness and the coefficient of conservatism or plant fidelity to a unique habitat type. Those areas with a FQI greater than 20 per ¼ m^2 are considered very high quality, while degraded remnants typically have an FQI of 5-10 per ¼ m^2 (Packard and Ross 1997). FQI values for the stands proposed for restoration in this project are based upon entire stand size and are not standardized to a ¼ m^2 survey boundary. For the basis of indicating stand richness and comparing pre- and post-treatment trends, the FQI will serve as a monitoring tool and assist in determining the adaptive treatments that would be needed.

Botanical survey results indicate that most stands identified for potential savanna restoration in this project have multiple savanna remnant nectar plants present. The density of plant species present was not uniformly sampled. Those that were surveyed for percent-perceived stand cover, and those stands which were anecdotally described, indicate that few of the stands contain a high enough percent cover of the lupine (5-15% cover) and nectar species (5-15% cover) to provide good quality habitat for the Karner blue butterfly. A minimum of four different types of nectar plants in each flight season is needed to support Karner blue butterfly, and lupine must be present at the percent cover indicated. High quality habitat would include lupine and eight or more nectar species in each flight season. Savanna remnant indicator species found in the Project Area included: Junegrass, lupine, frostweed, hairy bush clover, racemed milkwort, Hill's thistle, Kalm's brome grass, blackseed speargrass, goat's rue, dense blazing star, and bird's foot violet. First flight nectar species present included: bastard toadflax, birdsfoot violet, Carolina rose, common cinquefoil, dewberry, frostweed, hawkweeds, ragwort, wild lupine, wild strawberry, flowering spurge, erigeron, bluets, dwarf dandelion, hoary puccoon, yarrow and lousewort. Second flight nectar species present included: black-eyed susan, blue toadflax, butterfly weed, blazing stars, daisy fleabane, dewberry, flowering spurge, goat's rue, hairy bush clover, harebell, hoary puccoon, horsemint, lance-leaved coreopsis, bluets, hawkweeds, racemed milkwort, rough blazing star, sweet everlasting, dogbane, spirea, bedstraw, common milkweed, New Jersey tea, wild bergamot, woodland sunflowers, yarrow, Hills thistle, thimbleweed, evening primroses, asters and goldenrods.

While the diversity of nectar plants in many stands is good, the abundance is below a level needed for good pollinator habitat. Emphasis would be placed on conserving the present seed bank and the existing native plant populations, while encouraging greater density of flowering nectar species. Table 3.8 indentifies the management strategies associated with supplementing the existing native nectar plants in the Project Area.

Table 3.8: Management Strategies for the Seeding of Nectar Plants

	Current Nectar Species Composition Category			
	No Lupine	**Lupine present, less than 4 nectar species in both seasons**	**Lupine present, 4-7 nectar species in both seasons**	**Lupine present, 8 or more nectar species present in both seasons**
Treatment Recommendation	Plant lupine	Plant to increase nectar species presence and treat (i.e. burn, fence) to increase population density of desired plants.	Plant to increase nectar species presence and treat to increase population density of desired plants. Plant by either over-seeding after burn or scarify/disc areas of Pen sedge and seed or plant plugs of nectar plants.	Monitor and treat to increase population density of nectar plants. Scarify/disc areas of Pen sedge and seed or plant plugs of nectar plants without disturbing current nectar plant populations.

As much as it is possible, southern Michigan native genotype plant materials will be used for savanna restoration in accordance with the Forest Service Native Plant Species Framework (2008) as indicated in the Forest Service Manual Section 2070.3 that states:

"the FS is to ensure genetically appropriate native plant materials are given primary consideration in revegetation, restoration and rehabilitation of National Forest System lands, and that genetically

appropriate plants are those genetically diverse to respond and adapt to changing climates and environment conditions; unlikely to cause genetic contamination and undermine local adaptations…and are likely to maintain critical connections with pollinators."

As noted by Schoonhoven, et. al. (2005), local genotype plant materials may be an important factor in sustaining local insect populations. The following sources will be used for seed procurement:

1. Michigan-sourced seed from a Michigan-based native plant grower (to the extent that Michigan genotype seed is available);
2. Wisconsin-sourced seed (when or if Michigan-sourced seed is not available in a sufficient supply);
3. Other western Great Lakes states sources (if Wisconsin supplies are also exhausted); and
4. Supplement plant materials collected locally on the District by contracted growers and/or limited in-house efforts.

Non-Native Invasive Plant Species

The Huron-Manistee National Forests has identified certain plants as non-native invasive species (NNIS). Each listed species has a priority ranking for treatment. The management of NNIS is important because they have the capacity to transform or dominate native plant communities, and easily become established in areas that are frequently or severely disturbed, such as road clearings, landing sites, and skid trails. Nine species found in the Project Area have been identified for herbicide or mechanical treatment within stands where treatment would likely result in an increased spread of the NNIS due to the treatment activity (Table 3.9).

Table 3.9: NNIS Control Recommendations

NNIS Species	Forest Priority[1]	Management Options	Number of Locations[2]	Number of Acres[2]	Recommended Treatments
Leafy Spurge & Cypress Spurge	3	Control	16	17	Glyphosate
Autumn Olive	4	Control	11	11	Glyphosate or Triclopyr
Honeysuckle	2	Control	4	4	Glyphosate or Triclopyr
Japanese Barberry	2	Control/Eradication	1	1	Glyphosate or Triclopyr
Garlic Mustard	2	Eradication	1	1	Glyphosate, mechanical
Multiflora Rose	2	Eradication	1	1	Glyphosate or Triclopyr
Canada Thistle	4	Control/Eradication	3	3	Glyphosate, Mechanical
Scots Pine	4	Eradication	3	3	Mechanical
		Total Estimated	**41**	**42**	

[1]Ratings of Forest Priority are levels that determine the need to focus treatment attentions on either controlling or eradicating the NNIS. This rating takes into consideration such factors as current presence on the Forest, potential of spread, and the desired habitat characteristics.

[2]It is probable that this number would be slightly larger by the time treatment occurs due to movement and increased infestation.

Leafy and Cypress Spurge: These are two closely related species that have been identified for control treatments. They are aggressive and persistent weeds that are rapidly spreading throughout the mid-western United States. There are nineteen State legislatures that classify leafy spurge as a noxious weed, primarily because it is poisonous to cattle and causes severe eye irritation and possibly blindness in humans (Czarapata 2005). Leafy spurge is a known allelopathic plant, meaning that it modifies the soil environment of the areas where it occurs. This may result in an inability of native plants to persist in the immediate area of the plants. Control of spurge is difficult and must begin prior to the establishment of desired native vegetation (Biesboer (updated by Eckhardt) 1996). No single mechanical control method (e.g. smothering, discing) has proven wholly effective at control or eradication of spurge (Czarapata 2005). However, prescribed burning, in conjunction with herbicide application, can provide effective control of leafy spurge. Burning may either precede or follow spraying, but as with other methods, repeated treatments are necessary over at least a 5-10 year period. Surveillance and reapplication of herbicide must continue for at least 10 years to assure control and eradication (Biesboer (updated by Eckhardt) 1996). Glyphosate is most effective when applied after seed set in mid-summer or in late September after fall regrowth has started, but before a killing frost.

Autumn olive: This species occurs frequently throughout the Project Area in disturbed areas, early-successional fields, pastures, landings, and roadsides. Once established, it can eliminate almost all other plant species. Originally planted for its perceived benefits to wildlife, it has since spread profusely via bird feces. The Nature Conservancy (Sather and Eckardt 1987) notes that autumn olive has the potential of becoming one of the most troublesome invasive shrubs in the central and eastern United States due to its prolific fruiting, rapid growth, wide dissemination by birds, and its ability to easily adapt to many sites. In addition, because it fixes nitrogen in the soil, it can disrupt native plant communities that require less fertile soil (Czarapata 2005). Cut-stump and stem application of glyphosate has been effective at controlling autumn olive when used as a 10-20% solution. Although the product label specifies a higher concentration for cut-stump application (50-100%), this lower concentration has proven effective (Szafoni 1990). Thin-line basal bark treatments with triclopyr have demonstrated a 95% effectiveness rate at other locations on the District.

Honeysuckle: These are not yet well established in the Project Area; however, once established, honeysuckles can displace native woody species and reduce the overall species richness of native plant communities. This includes tree regeneration in early to mid-successional forests (Batcher and Stiles 2000). These effects result from their ability to grow to large size and replace native plants by crowding or shading them out and by depleting the soil of moisture and nutrients. Some exotic honeysuckles may also be allelopathic (Czarapata 2005). In addition, natural forest regeneration following disturbance can be severely impeded by these species (Sather and Eckardt 1987). A survey in 1998, found that most land managers used a glyphosate cut stump treatment for control of honeysuckle. For cut stump treatments, 20-25% solutions of glyphosate or triclopyr can be applied to the outer ring (phloem) of the cut stem. A 2% solution of glyphosate or triclopyr can be used for foliar treatments. The use of prescribed fire may also be effective when the density is low and sufficient fuels are available (Sather and Eckardt 1987). Effective mechanical management requires a commitment to cut or pull plants at least once a year for a period of three to five years (Sather and Eckardt 1987).

Japanese and European Barberry: These are aggressive, spiny shrubs that can survive well in shade and in wet or well-drained soils. Only one location of barberry was noted in the Project Area. The plant regenerates by seed, branch tip rooting, and creeping roots. Cutting or digging plants out in the spring can be effective for small infestations and small plants. Triclopyr has been used as a cut-stump treatment (WI DNR 2010). Glyphosate may also be effective.

Garlic Mustard: This allelopathic biennial can prevent even forest tree regeneration once it becomes well established. Seeds have been reported to survive up to 10 years in the soil. Control requires annual treatments until no new plants occur (often over a period of 10–12 years). Small populations can be eradicated by hand pulling if all of the flowering plants are pulled prior to seed formation. However, even cut stem flowering plants can produce viable seed (Sheehan 2007a). Burning may also aid in control efforts (Sheelan 2007a). Herbicide application, such as glyphosate at 2%, can be very effective, though annual checks are important to prevent the establishment of satellite infestations. Populations are estimated to double in size every four years if left untreated, but disturbance can lead to a 200–1,000% increase in just one year (Sheehan 2007a).

Multiflora Rose: This woody perennial invades old fields, open prairies, forests, oak savannas, fencerows and roadsides, river banks, and prairie fens. The dense growth of the foliage and stems inhibits the growth of competing native plants (Sheehan 2001). Multiflora rose was found in only one location in the Project Area. Multiflora rose reproduces by seeds and by rooting at the tips of its drooping canes. The fruits are highly sought after by birds, with seedlings often being found under bird perch sites. Eckardt (1987 and 2001) notes that the most effective means of controlling this species includes cut stem application. Glyphosate is commonly used and can be effectively applied to the plants, cut branches, or stumps in a 0.5-1% solution. Repeated mowing will control the spread of multiflora rose, with a recommended 3 to 6 mowings or cuttings per year, repeated for 2 to 4 years (Sheehan 2001).

Canada Thistle: This is an erect rhizomatous perennial, that is distinguished from all other thistles by creeping horizontal lateral roots, dense clonal growth, and small dioecious (male and female flowers on separate plants) flowerheads (Nuzzo 1997). Canada thistle is considered the worst invasive thistle as it is a prolific seed producer (estimates range from 1,500 to 40,000 seeds per plant) and it fills disturbed ground with its rosettes (Annen 2007). There are numerous ecotypes that respond differently to management activities. Some infestations may be completely controlled by one technique, while others will only be partially controlled because two or more ecotypes are present within the population. Additionally, treatment response varies under different weather conditions. Therefore, it is often necessary to implement several control techniques, and to continuously monitor their impacts. The best option in prairies and other grasslands is to first enhance growth of native herbaceous species by spring burning, and then cut or spot treat Canada thistle with glyphosate (2.5% solution) when it is in late bud or early bloom (usually June) (Nuzzo 1997). Mechanical treatments (i.e. burning, mowing, and tilling) are most effective in June, when the root carbohydrate reserves are minimal. Mowing, done several times a year, should be repeated for several consecutive growing seasons (Annen 2007). For this project, sites with Canada thistle will have prescriptions for control which would include a combination of mechanical and herbicide treatment.

<u>Scots Pine:</u> This non-native tree is most often found in relatively open upland areas; however, it may also be present in mixed forests and as the major component of planted conifer stands. It spreads through seed dispersal and has an average range of 50–100 m from the parent (Sheehan 2007 b). Due to the preferred habitat characteristics of Scots pine, it may serve as threat to savanna habitat (Sheehan 2007b). Recommended control methods include girdling and shearing/herbiciding. For girdling, bark and phloem is removed from a 10 cm band around the trunk.

In addition, other HMNF NNIS species are present within, or at the edges of, stands recommended for savanna restoration. These species are generally more abundant on the Forest and are only recommended for herbicide treatment in the event that competition from these species is likely to hinder the establishment or abundance the nectar plant species required by the Karner blue butterfly. These NNIS species are listed in Table 3.10. These would only be treated when determined through monitoring that their presence or abundance poses a risk to the success of the project. Treatments would be adaptive to site-specific conditions and would include a combination of mechanical and chemical treatment methods.

Table 3.10: Herbicide Recommendations for Non-Native and Undesired Plant Species Hindering Establishment of Karner Blue Butterfly Nectar Plant Species

NNIS or Undesired Plant Species	Forest Priority[1]	Recommended Herbicide(s)
Bracken Fern	Undesired[2]	Glyphosate
Canada Thistle	4	Glyphosate
Pennsylvania Sedge	Undesired[2]	Glyphosate
Hoary Alyssum	4	Glyphosate
Orchard Grass	4	Glyphosate
Reed Canary Grass	4	Glyphosate
Smooth Brome	4	Glyphosate
Sow Thistle	5	Glyphosate
Spotted Knapweed	4	Glyphosate
St. John's Wort	4	Glyphosate
Queen Anne's Lace	4	Glyphosate
White Sweet Clover	4	Glyphosate

Table 3.10 (continued): Herbicide Recommendations for Non-Native and Undesired Plant Species Hindering Establishment of Karner Blue Butterfly Nectar Plant Species

Yellow Rocket	4	Glyphosate
Yellow Sweet Clover	4	Glyphosate
Woody Stump Sprouts	Undesired Sprout[3]	Glyphosate, Triclopyr, or Imazapyr

[1]Ratings of Forest Priority are levels that determine the need to focus treatment on either controlling or eradicating the NNIS. This rating takes into consideration such factors as current presence on the Forest, potential of spread, and the desired habitat characteristics.

[2]Undesired plants are those native plants known to be highly aggressive and have been shown on the Forest, and around the region, to form thick covers preventing the establishment or abundance of other desired native species. These species would not be treated for elimination from a stand, but would be treated in patches to allow for greater abundance of other desired Karner blue butterfly nectar species and increased species richness.

[3]Undesired sprout includes the herbicide stump treatment of trees, especially oaks, cut to open up canopy cover and restore/create savanna habitat for Karner blue butterfly. In cases where timber cuts and burns are not sufficient to remove individual trees, stump application may be applied.

An additional strategy to prevent and limit the spread of all of the Forests' identified NNIS species is to pre-treat harvesting equipment (cleaning of mud, debris, etc.). For this project, this would occur in areas where ground disturbing treatments could potentially introduce or increase the spread of these species. The target species for pre-treatment activities include: yellow rocket (*Barbarea vulgaris*), hoary alyssum (*Berteroa incana*), smooth brome (*Bromis inermis*), spotted knapweed (*Centaurea biebersteinii [maculosa]*), Canada thistle (*Cirsium arvense*), orchard grass (*Dactylis glomerata*), Queen Anne's lace (*Daucus carota*), autumn olive (*Elaeagnus umbellata*), St. Johns wort (*Hypericum perforatum*), white sweet clover (*Melilotus alba*), and reed canary grass (*Phalaris aurundinacea*). The list of target NNIS would be expanded in the areas of Karner blue butterfly habitat creation or restoration. The matrix summarizing equipment cleaning by stand is located in the Project File (Baldwin Ranger District).

In addition, areas that are seeded or planted with native nectar species will need to be monitored for the presence of NNIS for 3 to 5 years following the seeding or planting. It is expected that hand pulling of weeds in seed plots would effectively eliminate NNIS problems in native seed beds in most cases as long as hand-pulling occurs prior to seed dispersal by the invasive plant species. In cases of seeding failure, stands may need to be retreated and reseeded to eliminate creation of a stand dominated by NNIS species.

<u>Threatened/Endangered/Regional Forester Sensitive Plant Species</u>

Field surveys were conducted in the SER project area during the 2006 through 2010 field seasons. During these surveys, no Federally Threatened or Endangered plant species were found. It is not expected that any occur within the Project Area.

Regional Forester Sensitive Species (RFSS) are species listed by the Regional Forester that have a national or state ranking of 1-3, have potential habitat or populations on the Forest, and are shown by Risk Evaluation to be at risk. RFSS found within the Project Area included Alleghany plum *(Prunus alleghaniensis var. davisii)*, purple milkweed *(Asclepias purpurea)*, and Hill's thistle *(Cirsium hillii)*. Table 3.11 identifies those locations where RFSS were found in the Project Area during field surveys.

Table 3.11: Regional Forester Sensitive Species Identified in the Project Area

Regional Forester Sensitive Plant Species	Compartment	Stand(s)
Alleghany Plum *(var. davisii)*	414	35, 41, 43, 44, 46, 59, 60
	416	5, 13, 42, 44, 50, 54, 55
	418	65, 82, 92, 117, 120, 130
	422	8, 17, 19
	458	17, 18, 21
Hill's Thistle	414	41, 43, 44, 46, 50, 59, 60
	416	7, 8, 9, 13, 32, 36, 44, 50, 52, 53, 55
	439	4, 10, 42
	458	25, 41, 45
Purple Milkweed	438	24, 63

Several other rare plants or species of concern have been found during other periods of observation within or close to the Project Area (MNFI database 2010). These species include: black-fruited spike-rush (*Eleocharis melanocarpa*, State Special Concern), prairie smoke (*Geum triflorum* - State Threatened, RFSS), bastard pennyroyal (*Trichostema dichotomum*, State Threatened, RFSS), false pennyroyal (*Trichostema brachiatum*, State Threatened, RFSS), bald-rush (*Rynchospora scirpoides*, State Threatened, RFSS), dwarf bulrush (*Hemicarpha micrantha*, State Special Concern, RFSS), purple spike rush (Eleocharis atropurpurea – State Endangered, RFSS), Tall Beak-rush (*Rhynchospora macrostachya*, State Special Concern), Whorled Mountain mint (*Pycanthemum verticillatum*, State Special Concern, RFSS), tall green milkweed (*Asclepias hirtella*, State Threatened), umbrella grass (*Fuirena pumila* – State Threatened, RFSS), Wahoo (*Euonymus atropurpurea* – State Special Concern), prairie dropseed (*Sporobolus heterolepis*, State Special Concern, RFSS), tall nut rush (*Scleria triglomerata*, State Special Concern, RFSS), and Vasey's rush (*Juncus vaseyi*, State Threatened, RFSS).

In addition to sensitive plants which have been found within or close to the Project Area, there are also habitats present that have the potential to support other sensitive species. Table 3.12 lists plant RFSS for the HMNF and indicates whether habitat(s) exist in the Project Area for that species.

Table 3.12: Habitat Determinations within the Project Area for Regional Forester Sensitive Species

Scientific Name	Common Name	Habitat	Code*
Agoseris glauca	pale agoseris	Prairies and jack pine/savannas with calcareous gravelly subsoils	1,2,3
Ahtiana aurescens	yellow ribbon lichen	Near bogs or water in old-growth forests on cedar, pine, or occasionally hardwoods.	1,3
Amerorchis rotundifolia	small round-leaved orchid	Northern boreal forests, bogs, cedar swamps, moors	2,3
Arabis missouriensis	Missouri rock cress	Oak or pine savannas/barrens; also found in wet, alkaline habitats	Y

Scientific Name	Common Name	Habitat	Code*
var. deamii			
Armoracia lacustris	lake cress	Quiet water or muddy shores, rivers, and lakes, especially in cold spring-fed water	2,3
Asclepias purpurascens	purple milkweed	Oak/pine barrens, prairies, shrub thickets, roadsides	Y
Aster sericeus	Western silvery aster	Prairies, dry banks, and fields	Y
Astragalus canadensis	Canadian milkvetch	Dry prairies, moist shores, river banks, marshy ground, other open or partially shaded ground	Y
Botrychium oneidense	Oneida grape fern	Moist, shady, acidic woods and swamps; hardwoods; canopy openings and treefall gaps	2
Botrychium rugulosum	ternate grape fern	Open fields, secondary forests	Y
Bouteloua curtipendula	side-oats grama	Oak barrens, dry grassy openings	Y
Carex lupiliformis	false hop sedge	Swales, marshes, swamps, floodplain forests, woodland depressions	Y
Carex schweinitzii	Schweinitz's sedge	Shaded streambanks	Y
Castanea dentate	American chestnut	Dry to mesic oak-hickory forests	Y
Cirsium hillii	Hill's thistle	Oak/pine barrens, prairies, grassy openings	Y
Cladonia robbinsii	yellow tongue cladonia	Soil and soil-covered rocks in open woods, roadsides, and fields	1
Cynoglossum virginianum var. boreale	Northern wild comfrey	Mixed forests, edges, openings	Y
Cypripedium arietinum	ram's head lady-slipper	Cedar swamps and lowland conifers in south/central Michigan	2,3
Dalibarda repens	false-violet	Moist, acid duff within mature pine stands; usually in undisturbed mesic/wet soils under full canopy	2,3
Dryopteris goldiana	Goldie's wood fern	Dense moist woods, especially ravines, limey seeps, or edges of swamps	2,3
Eleocharis atropurpurea	purple spike rush	Coastal plain marshes, moist acid sands	2,3
Eleocharis engelmannii	Engelmann's spike rush	Wet depressions, coastal plain marshes	2,3
Eleocharis tricostata	three-ribbed spike rush	Coastal plain marshes, moist acid sands	2,3
Eupatorium sessilifolium	upland boneset	Oak barrens, oak stands	Y
Festuca scabrella	rough fescue	Jack pine barrens, dry northern forest, often associated with calcareous, gravelly subsoils	1
Fuirena squarrosa	umbrella-grass	Coastal plain marshes, moist acid sands	2,3
Geum triflorum	prairie smoke	Oak woodland bluffs, sandy prairie, thin soil over limestone	Y
Heterodermia obscurata	orange-tinted fringe lichen	On hardwoods; old-growth indicator	2,3

Scientific Name	Common Name	Habitat	Code*
Huperzia selago	Northern fir-moss	Lakeshore swales, conifer swamps, rocky shorelines and outcrops, open dunes, calcareous seeps	2,3
Hypericum gentianoides	orange grass or Gentian leaved St. John's-wort	Sandy acid wet or dry soils, at edges of damp wet prairies, open habitats	2,3
Juglans cinerea	butternut	Floodplains, hardwood stands, homesteads, swamp forests	Y
Juncus brachycarpus	small-headed rush	Moist/wet meadows and shores on mineral or organic soils	2,3
Juncus vaseyi	Vasey's rush	Moist/wet meadows and shores on mineral or organic soils	2,3
Kuhnia eupatorioides	false boneset	Dry, open areas, prairies	Y
Lechea pulchella	Leggett's pinweed	Prairies, undisturbed openings	Y
Linum sulcatum	furrowed flax	Dry, open sandy soils and prairie remnants	Y
Liparis lilifolia	lily-leaved twayblade	Subirrigated sands under conifers or hardwoods, wet shrubby thickets	2,3
Liphocarpha micrantha	dwarf bulrush	Exposed wet/moist sands associated with coastal plain marshes, lakeshores	2,3
Lycopodiella subappresssa	Northern appressed club-moss	Lake plain prairies, interdunal wetlands, wet open ground (disturbance)	2,3
Malaxis brachypoda	white adder's-mouth	Sphagnum bogs, moist hardwoods/cedar stream banks	2,3
Mertensia verginica	Virginia bluebells	Wooded floodplains	2,3
Orobanche fasiculata	Fasicled broom-rape	Dunes and dry/wet interdunal areas	2,3
Panax quinquefolius	American ginseng	Mature hardwoods mixed aspen/hardwoods with rich soil	2,3
Poa paludigena	bog blue grass	Bogs, acidic swamps	2,3
Polygala cruciata	cross-leaved milkwort	Intermittent wetlands coastal plain marsh, exposed water tables	2,3
Potamogeton bicupulatus	waterthread pondweed	Ponds and marshes	2,3
Prunus alleghaniensis var. davisii	Alleghany plum	Openings, old fields, prairies, roadsides	Y
Psilocarya scirpoides	bald-rush	Marly bogs, grassy swales, coastal plain marshes	2,3
Pterospora andromedea	pine-drops	Pine stands, hardwood stands	Y
Pycnanthemum pilosum	hairy mountain-mint	Undisturbed upland oak, old fields, openings, roadsides	Y
Pycnanthemum verticillatum	whorled mountain mint	Sand shorelines, coastal plain marsh, exposed water tables	2,3
Rhexia virginica	meadow-beauty	Intermittent wetlands, coastal plain marshes and coastal plain marsh complexes	2,3

Scientific Name	Common Name	Habitat	Code*
Scirpus hallii	Hall's bulrush	Sandy lakeshores, coastal plain marshes	2,3
Scirpus torreyi	Torrey's bulrush	Muddy or sandy lakeshores, peaty or mucky edges of marshes	2,3
Scleria pauciflora	few-flowered nut-rush	Coastal plain marshes, moist acid sands	2,3
Scleria triglomerata	tall nut-rush	Wet prairies, coastal plain marshes	2,3
Sisyrinchium atlanticum	Atlantic blue-eyed grass	Coastal plain marshes, moist sandy shores, wet prairies	2,3
Sporobolus heterolepis	prairie dropseed	Calcareous fens, prairie wetlands	2,3
Taxum Canadensis	Canadian yew	Rich, often swampy woods; dunes	2,3
Trichostema brachiatum	false pennyroyal	Calcareous soils, old fields, openings, dry prairies, roadsides, rights-of-way, occasionally disturbed sites	Y
Trichostema dichotomum	forked bluecurls or bastard pennyroyal	Old fields, open habitat in oak/pine barrens, prairies, openings	Y
Triplasis purpurea	purple sandgrass	Sandy openings	Y
Viola novaeangliae	New England violet	Gravelly and sandy shores, mesic sand prairies, rock crevices along waterways	2,3

** Code: The species was not included in this assessment because:*

1. *The species has not been documented to occur on the Manistee National Forest,*
2. *The species is found in habitat(s) unlike those found in the proposed Project Area,*
3. *The species was not found during field surveys of the proposed Project Area and/or there are no known records of the species in the Project Area,*

Y (Yes): The Species was included in the assessment either because the species was found during field surveys; a past record has indicated the species presence in the Project Area; or the habitat for the species exists within the Project Area.

(3.4b) Area of Analysis

The area of analysis for the direct and indirect effects on the herbaceous vegetation is the National Forest System lands where treatments would occur, and adjacent National Forest and private lands within ¼ mile of treatment sites. This area represents a reasonable distance for plant seed dispersal. The area of analysis for the cumulative effects is the southern and middle portions of the lower peninsula of Michigan. This area has been identified due to the similarities across this region relative to growing conditions, plant species composition, and the impacts related to human activities.

(3.4c) Direct and Indirect Effects

Effects on Savanna and KBB Plant Species

Timber Harvesting: Under Alternative 1, no timber harvesting would occur. Disturbance would be limited to that of natural origins such as wildfire or wind throw. Oak stands would continue to mature and areas of more open lands would continue to fill in with woody vegetation. As aspen stands continue to age and decline, other woody species would begin to replace aspen as the dominant cover type. For savanna species that are light dependant, continued maturing of forested lands would likely result in declining savanna nectar plant species.

Under Alternatives 2 and 3, timber harvesting would occur in the form of pine thinning, scotch pine removal, oak/pine cuts for savanna restoration (discussed in the next section), and oak/aspen clearcutting. Savanna and KBB nectar plant species require generally open conditions. While the canopy would decrease in the short-term following timber harvest, open conditions would not persist for any real net increase in savanna/nectar plant habitat availability without continued management efforts such as prescribed burns to maintain openness. In some forested stands, however, KBB nectar plants are currently present and would be expected to increase in the short-term with an increase in canopy openings. In addition, some KBB nectar plants are also non-native plants with an early-successional pioneer strategy. It is likely that these species (such as hoary alyssum, the hawkweeds, spotted knapweed, and St. Johnswort) would become established in the newly opened areas. Studies suggest that openings or corridors within forested stands can support Karner blue butterflies if lupine and other nectar species are present (Kleintjes, et al. 2003). In areas already populated by KBB, an increase in lupine and nectar plant presence in a heterogeneous habitat setting would provide a close proximity of shade plus lupine/nectar.

Savanna Restoration: Under Alternative 1, no treatment would occur. The only disturbance occurring would be that of natural origin such as wildfire or wind throw. Plant succession would continue to progress, woody vegetation would continue to dominate the landscape in forested areas, and would continue to encroach upon, and expand within, openings. Biodiversity of fire-dependant savanna herbaceous plants would continue to decrease in semi-open canopy oak forest, as more competitive species (such as Pennsylvania sedge) would continue to increase.

Under Alternatives 2 and 3, treatment activities would occur to reduce woody vegetation and encourage the presence and abundance of savanna and KBB nectar plants. Alternatives 2 and 3 would promote an adaptive management approach to savanna restoration, with each potential treatment action having the results monitored prior to implementation of another treatment action. In some cases, one or two initial treatments could potentially be sufficient to meet objectives, without additional types of treatment being implemented.

Herbicide use may be used to reduce resprouting of cut woody vegetation. There would be some negative effects on savanna/nectar plants if any herbicide came into contact with adjacent, non-target vegetation. Efforts would be made to minimize this risk. There would also be the potential for spot and strip application of herbicide to also injure or kill adjacent or nearby non-target plants. Biologist/botanist identification of herbicide spray locations in the savanna treatment units would minimize the effects of herbicides on savanna/nectar species whose presence is determined to be of importance to meeting the project objectives. There would also be potential effects associated with the use of triclopyr and imazapyr. Triclopyr can affect non-target plants due to some accumulation in the soil and the related plant uptake through the roots (Newton, et al. 1990). Imazapyr may cause damage to nearby non-target plants due to the release of imazapyr from the roots of treated target plants (Tu, et al. 2004).

Prescribed burning is a preferred method of treatment for savanna restoration, as it mimics natural wildfire conditions that were instrumental in maintaining pre-settlement savanna conditions. Prescribed burning, depending upon timing and fire intensity, would result in a reduction of woody plants, release nutrients for herbaceous plant growth, decrease the presence/abundance of non-fire adapted plant species, increase soil exposure to solar warming to favor warm season grass growth, and open up the ground layer for the seed germination of savanna species. Overall, there would be a positive response for nectar savanna plants, though vegetative monitoring would be essential to prevent unacceptable increases in the abundance of bracken fern or Pennsylvania sedge that may occur as a result of prescribed burning activities.

Soil scarification would occur following fire or due to mechanical scarification treatments. These would promote the establishment and growth of species present in the existing seedbank, and would favor opportunistic species. Negative effects would occur for savanna plant community composition when NNIS species are stimulated by scarification. However, many NNIS species are also nectar sources for KBB, so the negative aspect of invasiveness would be relative to the balance of plant species composition, long-term consequences for plant community composition due to invasive plant competition, and the role in providing nectar to insects. Positive effects would occur for native species which are stimulated by the soil exposure, such as lupine and Hill's thistle. Scarification by fire would benefit those species adapted to a fire-dependant ecosystem and would encourage an increase in more conservative savanna species such as June grass, lupine, birds-foot violet, and others.

Mechanical scarification would not supress non-fire adapted species or encourage savanna fire-dependant plants. It would result in a change in plant composition dependant upon successful herbicide application and the subsequent planting/seeding of native species. It would provide a positive benefit in situations where Pennsylvania sedge forms a monotypic mat that precludes the presence of most other plant species. Scarification to break up the root mass of the sedge, followed by herbicide application and subsequent planting of natives would help improve stand biodiversity and increase the presence/abundance of savanna/nectar species. Mechanical scarification in areas that already have a good nectar seedbank would potentially encourage invasive plants and may kill off seed sources of more conservative nectar or savanna species, or species that are not commercially available for re-planting, thus moving the stand away from target goals of a diverse herbaceous layer with a variety of nectar species.

The planting of plugs or seeding of native plants to serve as innoculum for the remainder of the stand would result in an increase in either the number of savanna or nectar species present or an increase in the abundance of species already present at lower densities. This would provide a positive effect of recruiting additional savanna/nectar species where the species is currently not present. An increase in abundance of species already present would primarily be of benefit for meeting wildlife objectives. To avoid a negative impact on existing nectar species in the stand, plugs would need to be placed outside of areas which already have good nectar species presence.

Under Alternatives 2 and 3 southern Michigan genotype seed source plant material would be used to the extent market availability and funding allow. Studies suggest that genetic variability is such that, for some species, regional variations may affect successful food support for pollinators (Tallamy 2007). Greater plant genotypic biodiversity has been shown to support greater insect species richness (Crutsinger, et. al. 2006). Restoration using non-local seed could result in genotypes that persist for a long period of time (Gustafson, et al. 2005), affecting growth form, phenology and competition between local and non-local genotypes, and ultimately, pollinator insect support. Other recent studies are also highlighting the consequences of habitat fragmentation that results in genetic erosion and loss of genetic diversity that allows plant populations to maintain a mutation-drift balance and be able to better adapt to changing environmental conditions (Honnay and Jacquemyn 2006).

Increased open lands favoring herbaceous vegetation would likely result in an increase in deer browse. Herbivory has a noted effect on reduced nectar presence in the Project Area. The added density of cut woody stems from canopy opening treatment would also likely add to the presence of rabbit and small mammal habitat which would result in additional herbivory pressure on savanna nectar species unless brush/woody debris piles are removed from the Project Area or are chipped. Increased levels of deer grazing would reduce native plant richness while increasing the presence of exotic invasive plants (Seabloom, et. al. 2009). Herbivory effects on native plantings would be reduced in areas where protective fencing is used. Fencing areas would allow for the enhanced development of nectaring flowers and the dispersal of seeds into other portions of the savanna.

<u>NNIS Treatments:</u> Under Alternative 1, no mechanical or chemical treatment of NNIS would occur as a direct result of this project. The treatment of high-priority species would still be allowed as part of the HMNF Non-Native Invasive Program (NNIP). NNIP treatments would be focused primarily on those species that are not yet well-established on the Forest, are located in sensitive areas, or that provide an increased or unique threat. Under this alternative, NNIS would continue to expand in the areas where populations currently exist; especially those areas that are disturbed or adjacent to openings. This would further reduce habitat for native savanna and KBB nectar plant species.

Under Alternatives 2 and 3, autumn olive, leafy and cypress spurge, non-native bush honeysuckle, Japanese barberry, Scots pine, multiflora rose, Canada thistle, and garlic mustard would be treated with herbicide to reduce population levels in selected stands. Leafy and cypress spurges, Japanese barberry, multiflora rose and non-native bush honeysuckles would be treated in all areas where other treatment activities are proposed. The elimination of these species from these areas would provide an increase in the amount of habitat available for the establishment of native savanna/nectar species. Canada thistle would only be treated in stands designated for savanna restoration where thistle presence is a deterrent to successful restoration. Autumn olive would be treated in stands which are to be managed to maintain open conditions for savanna/nectar plant species. This treatment would promote the desired open conditions and would prevent soil chemistry changes (nitrogen fixation) associated with autumn olive which can alter the habitat suitability of other native species that are adapted to open conditions.

Under Alternatives 2 and 3, additional NNIS treatment would occur in the areas being managed to promote nectar plant species and increasing KBB habitat. Herbaceous NNIS species that are considered a threat to KBB nectar plant establishment and persistence would be treated with herbicide. Additional treatments would also focus on areas where NNIS species are currently present along trails and roads, as these areas serve as sources of potential spread into the interior of adjacent stands. Focusing treatments in these areas would reduce the risk of NNIS spreading into new areas and negatively impacting present or established nectar plant species.

Allelopathic NNIS species (such as spotted knapweed) would be targeted where they are present in the interior of the stand. In most cases, it would be possible to limit the spray activities to a handheld sprayer or a wick application for single stem or small clump application. In areas of greater infestation, strip application of herbicides would occur. In these areas all plants within the strip would be killed, including some desirable savanna/nectar species. The negative effects of applying herbicides to desirable savanna/nectar species would be short-term for species that are able to be reseeded into the affected strips. Some savanna species are not easily re-established or are not commercially available. It is possible that there would be some negative effect of reducing the presence of some savanna species due to herbicide application, particularly in the areas receiving strip application. This effect would be mitigated by marking and excluding or providing protective covering to more conservative savanna/nectar species prior to herbicide application.

<u>Transportation, Recreation, and ORV Damage:</u> Under Alternative 1, no changes would occur to the current transportation system and the management of this system would be consistent with the Motor Vehicle Use-Map (2009). Roadways would continue to function as a vector for NNIS introduction and as a seed dispersal corridor.

The closing of roads under Alternatives 2 and 3 would reduce this vector. As a result, these alternatives would benefit savanna plant species since less native habitat would be lost to invasive plants. There would probably still be some NNIS movement along closed roadways for those plants already established along road corridors. Since the closed roads would not be obliterated, there would be no gain in habitat for sensitive species.

Throughout the Project Area (and especially in the White River Semiprimitive Nonmotorized Area (WRSNA), horseback riding is a popular recreational activity. Under Alternative 1, no changes would occur in horse-related recreational activities. Field surveys within the Project Area indicate that horse use is affecting plant habitat through: erosion of soils in sensitive areas, destruction of vegetative layers in areas frequented by horse camps, and the opening of the soil layer to NNIS establishment. Continued horse use in this area would promote the continuance of new introductions of additional weed, as horses have been documented as retaining seed from feed for 4–10 days and eliminating seed into new areas (Wells and Lauenroth 2007; Pickering and Mount 2010). Horse presence can also cause possible enhancement of growth of non-desirable plant species due to soil chemistry changes from manure loading (Westendorf 2009). Savanna nectar species are particularly noted for their ability to thrive or at least exist in nitrogen poor soils. A number of important savanna nectar species have a nitrogen fixing ability within their root system that gives them a competitive advantage for existing in poor soils. As manure, or fertilizer is added to the soil, that competitive advantage would be lost to other species.

Under Alternative 2, horses would be confined to a designated trail within the WRSNA. As a result, the impacts of horses in this area would be much reduced (compared to dispersed horse riding in Alternative 1) as the impacts related to horses are generally the highest in previously untracked areas and lowest on constructed and maintained trails (Landsberg, et. al. 2001). Much of the proposed trail would occur in forested stands. While some impacts may occur from the introduction of weed species by horses or their riders, studies suggest that weed introduction in forested horse trail locations are limited (Campbell and Gibson 2001). Due to the concern regarding weed spread due to horses, however, periodic inspections would be made to determine if an increase in invasive species is developing along the designated trail route.

Under Alternative 2 horse camps would also be permitted in 11 designated locations within the Project Area. In these areas, manure would have to be removed by visitors when they leave the site. At these designated sites, anticipated effects would include an increase in the trampling of vegetation, added browse of herbaceous and some woody plants, added nitrogen loaded hotspots to the soil, and enhanced likelihood of introduction of invasive plants into the natural plant community. These 11 areas would represent a loss of potential habitat for savanna species. Again, similar to the designated trail, periodic inspections would enhance early detection of invasive plant introductions allowing for control before populations become well established to prevent designated camping areas from becoming NNIS sources.

Under Alternative 3, no horses would be allowed within the WRSNA. Currently used horse camp locations would be restored to natural vegetation conditions. The risk of horse trampling of savanna plants, compaction or erosion of soil, increased nitrogen loading and nitrogen hotspots, transfer of invasive plant materials and browse of natural vegetation would not occur in the White River area. While this activity would not be precluded in the Otto portion of the project area, horse-based recreation is an infrequent activity and would be expected to have negligible effects in this portion of the Project Area. This alternative would have the least impact of the three alternatives for herbaceous savanna species.

Off-road recreational vehicle use on the Forest is expected to occur on managed trails, however, illegal usage occurs on National Forest System lands and results in the destruction of plants and increases erosion damage to plant habitat. An example of such damage occurs in the northwestern portion of the WRSNA portion of the Project Area. In this area, there is a large blowout of sand which was created due to the loss of vegetation on sandy hills following ORV use. While restoration has been implemented by the Forest and the response has been good, there are still portions that remain unvegetated due to the difficulties associated with restoring vegetation in disturbed sand. The increase in the amount of open lands under Alternatives 2 and 3 would increase the area of land that would be attractive to this type of illegal usage. Increased enforcement would be necessary to improve early detection and remedial response to such activities occurring in the area.

In addition to horseback riding, there is seasonal recreational use throughout the Project Area associated with hunting, dispersed camping, and fishing. Some recreational users have caused vegetation impact areas by parking or camping on thin, poor, sandy soils, where native vegetation is easily eliminated and NNIS can become easily established. While some of this impact occurs on the edges of forested stands, if the proposed forested areas in Alternatives 2 and 3 are converted to more open lands, there is a greater potential for this impact to occur in more areas. Barrier fences have been installed along various roads throughout the Project Area to prevent such effects. Implementing the closure of Forest Service roads would reduce vehicle access to existing or newly created open areas. The creation of 11 designated camping locations along County roads in Alternatives 2 and 3 would encourage focused areas of impact in contrast to scattered areas of impacts throughout the Project Area.

<u>Effects on Non-Native Invasive Plant Species</u>

<u>Timber Harvesting:</u> Under Alternative 1, no timber treatment would occur. Some new infestations of honeysuckle and autumn olive would most likely occur in openings within wooded stands or at stand edges due to seed dispersal by wildlife or other vectors. Lack of soil disturbances typically associated with timber harvesting activities would limit the opening of the soil to new infestations in the interior of the stands. Continued canopy closure would limit the growth and spread of shade-intolerant invasive species such as autumn olive. Leafy and cypress spurges would continue to spread in forested and non-forested stands as opportunities occur for dispersal from current population locations.

Under Alternatives 2 and 3, timber harvest activities would result in soil disturbances conducive to NNIS establishment and population expansion. Equipment cleaning under these two alternatives would reduce the spread of NNIS related to the proposed vegetative treatments.

<u>Savanna Restoration:</u> Under Alternative 1, no treatments would occur. NNIS species, such as autumn olive, cypress and leafy spurges, and honeysuckle, would increase in open areas, reducing the amount of habitat available for native herbaceous species. NNIS species would likely spread to additional locations within the Project Area.

Under Alternatives 2 and 3, varied treatments for savanna restoration would occur using an adaptive management approach. After each treatment action, analysis would be made of resulting conditions to determine if or what type of additional treatments would be needed to provide a sufficient amount of quality habitat for the KBB. These treatments would affect NNIS levels. Timber removal by would result in soil disturbance that would be conducive to NNIS germination. Handcutting would have minimal effect on the NNIS species.

All of the prescribed burning proposed in this project would be used to help reduce invasive plants and encourage the growth of native herbaceous species that are characteristic of healthy ecosystems. Many invasive plants begin growth early in the spring, prior to native plants. This would make prescribed burning during the spring season effective for reducing many invasive species. Fire is most effective over time, gradually increasing the numbers of species that naturally occur in ecosystems, while reducing non-native and native invasive species until a natural balance is achieved (Chicago Wilderness 2003). The precise timing of burning can reduce specific NNIS species. For example, burning in late April to mid-May can greatly reduce spotted knapweed seedling survival (MacDonald 2007). Prescribed burns would result in an increase in NNIS species in situations where soil scarification occurs and weed seed sources are nearby. Prescribed burns would also result in an increase in some NNIS species such as autumn olive and leafy spurge due to a growth stimulation response to fire disturbance, unless cutting or burning of resprouts is done annually for up to 5 years. Plow lines constructed for fire control would result in soil exposure which would be conducive to NNIS germination. Immediate re-seeding of plow lines would help reduce this risk.

Seeding treatments would likely result in increases in NNIS presence in the disturbed soil in situations where weather conditions and/or timing of seed planting did not result in complete establishment of native plant species. This would be minimized, however, by limiting herbicide applications and seeding to appropriate weather and seasonal conditions, and by 3-5 years of subsequent weeding of new seedbeds.

<u>NNIS Treatments:</u> Under Alternative 1, no treatment would occur. NNIS species would continue to expand in population size, especially in areas adjacent to roadways and other areas of disturbance. New infestations of NNIS would likely occur. The diversity of native plants in the Project Area would decline as NNIS plants alter or replace native plants, and alter natural ecosystems (Westbrooks, 1998). Eventually, the population of an individual species would reach a level at which it would no longer be as feasible to eliminate it from the Project Area. Lack of prescribed fire would allow for the continued domination of more competitive species, as those species which are fire-dependant begin or continue to drop out of the habitat.

Under Alternatives 2 and 3, autumn olive, leafy and cypress spurges, non-native bush honeysuckle, Japanese barberry, garlic mustard, multiflora rose, and Canada thistle would be treated with herbicide to reduce population levels in selected stands. Leafy and cypress spurges would be treated in all treatment stands, in an effort to remove these species unless KBB monitoring indicates butterfly presence and herbicide is not approved for treatment. This would assist in restoring native plant habitat and minimizing the loss of native habitat due to invasive spurge population expansion. There would still be the possibility of the species proliferating in other portions of the Project Area that were not evaluated for treatment. There would also be a possibility of these species becoming reintroduced into the treatment stands at a future date due to nearby NNIS population sources. Autumn olive would be treated in stands which are to be managed for open conditions. This would prevent the soil chemistry changes (nitrogen fixation) which alters habitat conditions for native plant species. Japanese barberry, honeysuckle, multi-flora rose and garlic mustard are considered to be high-priority species for the Forest. Attempts would be made to mechanically or chemically eradicate these species where found. This would preserve future savanna habitat from invasive impacts. Canada thistle would be treated where determined to be causing a risk to the establishment or maintenance of savanna habitat.

Additional NNIS treatments would occur in stands being managed for nectar plant species to increase Karner blue butterfly habitat. Herbaceous NNIS considered a threat to the establishment or persistence of native nectar plants would receive herbicide application. Currently, infestations occur mainly along the existing roads and trails. Focusing treatment activities in these areas first, would limit the potential of these species spreading into the interior of surrounding stands.

Species that demonstrate allelopathic characteristics (i.e. spotted knapweed) would be targeted for population suppression in the interior of selected stands. While in most cases application would occur to single stems, there are a few locations that would warrant the strip application of herbicides. This would be followed by native seeding or planting. In areas of strip application, all of the plants within the strip would be killed. There would be a possibility of an increase in NNIS presence if the re-seeding of native plant species results in less than 100% cover during revegetation and/or if the seedbank contains viable NNIS seeds. This would be minimized by the weeding of all seedbeds for 2-5 years following seeding. Overall, the treatments for Alternatives 2 and 3 would result in a reduction of NNIS in Project Area openings.

Transportation, Recreation, ORV Damage: Under Alternative 1, no changes would occur to the current transportation system and the management of this system would be consistent with the Motor Vehicle Use Map (2009). Roadways would continue to function as a vector for NNIS introduction and as a seed dispersal corridor. The existing Forest Service road system would remain in place, and the threat of new introductions, and spread of existing NNIS would be sustained or increase with travel and visitor use. NNIS would likely germinate in soils exposed by ORV use. The consequence would be a reduction of habitat for native vegetation and those species that rely upon specific native plant species such as the Karner blue butterfly.

Under Alternatives 2 and 3, road closures would occur which would reduce the spread of NNIS through road maintenance activities such as plowing and grading, and would reduce the amount of vehicle disturbance that creates suitable conditions for the germination of NNIS. It would be expected that some spread of NNIS would still occur from populations already established along road corridors.

Under Alternative 2, horse use on National Forest System lands within the WRSNA would be limited to a designated trail, 11 camping sites, and two parking areas. There would be no limitations on this use on lands not under the jurisdiction of the Forest Service or in areas outside of the WRSNA. Under Alternative 3, no horse use would be permitted within the WRSNA portion of this Project Area. The effects of these actions on NNIS (as well as the effects on NNIS related to illegal ORV use) have already been discussed.

Effects on Threatened/Endangered/Regional Forester Sensitive Plant Species (TES)

Project analysis for TES plant species is found in the Biological Evaluation (Project Record). No federally threatened or endangered plant species are found in the Project Area. Three sensitive species (RFSS) were found in the areas proposed for treatment. These include: Alleghany plum, purple milkweed and Hill's thistle. The determination of the effects from this project on these species is summarized in Table 3.13.

Table 3.13: Determination Table by Habitat Type for Regional Forester Sensitive Plant Species

Habitat	Alternative 1	Alternative 2	Alternative 3
Oak Woodland	MINT[1]	MINT	MINT
Early Successional Forested (Aspen)	No Effect	MINT	MINT
Conifer Forested	No Effect	MINT	MINT
Dry-mesic Openings	MINT	MINT	MINT
Streambanks	MINT	MINT	Beneficial Effect

[1]MINT = May Impact, Not Likely To Trend. This determination can refer to positive or negative impacts, noting simply that there will be affects to the species or habitat, but none that would likely cause a trend towards threatened or endangered species listing or a loss of viability.

The determinations of project effects for sensitive species found in the areas proposed for treatment are summarized below in the Determination Table for Plant RFSS (Table 3.14).

Table 3.14: Determination Table for Regional Forester Sensitive Plants found in the Project Area

RFSS	Alternative 1	Alternative 2	Alternative 3
Alleghany Plum	MINT[1]	MINT	MINT
Hill's Thistle	MINT	Beneficial Effect	Beneficial Effect
Purple Milkweed	MINT	Beneficial Effect	Beneficial Effect

[1]MINT = May Impact, Not Likely To Trend. This determination can refer to positive or negative impacts, noting simply that there will be affects to the species or habitat, but none that would likely cause a trend towards threatened or endangered species listing or a loss of viability.

(3.4d) Cumulative Effects

Within the Project Area, there are three on-going vegetative treatment projects that were authorized through previous NEPA analysis. These are discussed above in the Woody Vegetation Section and include:

1. Approximately 50 acres in Greenwood Township that is being converted from red pine to an upland opening with treatments of timber harvest, prescribed burning, and seeding and planting to restore herbaceous savanna plant ecosystem;
2. Approximately 78 acres in Greenwood Township which have been converted from red pine and oak to upland openings to evaluate the effects of varying combinations of mechanical and prescribed burn treatments and to determine the best methods for returning pine and oak forest habitat to an herbaceous dominated savanna system; and
3. Approximately 346 acres in other upland opening sites within the Project Area where encroaching woody vegetaton will be removed to restore the areas to open conditions.

Within these treatment areas, woody vegetation will be reduced to an average of 5–20% canopy cover for overstory and 10–25% for understory saplings and shrubs. A suite of nectar producing herbaceous savanna species will be established by seeding or planting in areas where a natural flushing response of such species from the seedbank in the soil does not occur. Project activities are expected to occur over as long as a ten year period to re-establish a savanna condition. The effects of these projects will be a renewal of the savanna conditions that favor populations of the savanna nectar and RFSS species. The positive effects on these species would be additive to the ones generated from the current proposed project under Alternatives 2 and 3. Should Alternative 1 be selected for this proposed project, then the above treatments would allow for a limited remnant of savanna habitat to be maintained, enhanced, or slightly expanded.

Outside of the above-noted treatments, oak savannas would continue the state-wide trend of loss due to encroachment by and succession of woody vegetation, and invasive plant savanna habitat quality deterioration (MNFI 2009). Lack of fire, and other management tools to renew savanna habitat would result in a continuing trend of loss of habitat for RFSS savanna species, both on the Forest and within the historical savanna habitats of the southern to mid-lower Michigan peninsula.

Efforts are being made to restore savanna in other portions of the State as well. The Forest has initiated savanna restoration in the M37 Project Area and in portions of the Mast Lake Project Area, both in Newaygo County. The Forest also undertook an experimental restoration of pine plantation to dry sand prairie habitat in the Newaygo Experimental Forest. That project has not continued to completion at this point in time, as encroachment of red pine and other factors are contributing to delay in successfully attaining a restoration in the area. Some restoration on non-Forest lands is also occuring through support from The Nature Conservancy.

An increase in development on private lands is expected in the future. Such population growth would likely increase the number of residences within the cumulative impact area. This would decrease the amount of undeveloped plant habitat and increase the likely introduction of NNIS. Increased land development on private lands would create additional problems for rare plants by creating more isolated populations and reducing genetic exchange needed for healthy populations.

Herbivory is known to effect savanna or prairie herbaceous species. Small mammals have been shown to negatively affect forb species (Martinez-Garza, et. al. 2003) through grazing, and through seed predation (Bricker, et. al. 2010). Deer browse is also a major factor (Anderson, et. al. 2007) affecting forb species. Management to create more savanna is likely to increase effects of herbivory on savanna and sensitive plants in the Project Area and in nearby private lands.

Major highway corridors close to the Project Area will continue to bring visitors and vehicles into this area and promote the spread of NNIS. The Forest Service will continue to monitor and treat National Forest System lands adjacent to the Project Area to inhibit the spread of those NNIS of concern; however, because of the recreational use, new invasive species introductions are likely. Residential road construction, development, and equestrian use will create additional vectors for NNIS plants' dispersal along the network of county primary, secondary, and Forest Service roads.

Recreation and associated vehicle use will provide the disturbance necessary for the proliferation of the NNIS plants by generating soil disturbance and providing for the dispersal of seeds. The seeds and plant material are transported as vehicles move from one area to another, within and outside the Project Area. Forest and County roads open to motor vehicle use will provide locations for invasive plant species populations to increase, expand, and move into areas not currently infested.

All NNIS plants identified in the surveys of the Project Area are likely to spread and occupy more of the land base in the future, although at differing rates of spread. The Forest Service is forming partnerships with other agencies and landowners whose property serves as a source of non-native invasive plant species (Michigan Stewardship Network). Cooperative efforts can increase the likelihood of effective NNIS management by addressing both public and private land holdings with NNIS species present. In addition, the Forest has a wide-scale, limited-use pesticide Environmental Assessment to control and eradicate high-priority NNIS plants for up to 2,000 acres per year across the Forest.

Private landowners may use mechanical and chemical means to reduce the presence of weeds on privately held properties. No data currently exists to estimate how effective these treatments are in the analysis area. Agricultural landowners in the area are likely to use pesticides in their farming practices. Concern has been expressed during scoping that the Proposed Project might impact area agricultural practices of pesticide treatment and negative effects to Karner blue butterfly. No private agricultural lands are expected to occur in close enough proximity to the Project Area for an effect of private lands pesticide application on proposed expanded Karner savanna habitat.

Oak savannas have been decreasing in both quanitity and quality in the southern to mid-part of lower Michigan, largely due to lack of fire. Oak savanna areas would continue to be encroached upon by woody vegetation on both private and public lands, making them increasingly unsuitable for savanna nectar and RFSS plants. Lack of fire, and other management tools to renew savanna habitat would result in a continuing trend of loss of habitat for these species, both on the Forest and within the historical savanna habitats of the southern lower Michigan peninsula. Creation/restoration of the savanna and dry openings habitat in this proposed project would create a beneficial overall effect of increasing habitat for oak savanna nectar and RFSS plant species.

Conclusion: Alternatives 2 and 3 would result in an increase in favorable conditions for savanna and open habitat RFSS plant/nectar species, and would reduce NNIS populations and spread. Alternative 3 would result in removal of impacts from horse-related recreational activities, resulting in greater protection of restored savanna habitat. Alternative 1 would continue to contribute to the disappearance of adequate quality habitat for savanna and open habitat plant species, and would not lessen the negative effects of NNIS on native/sensitive/nectar plant habitat.